

Topic 11

Periodic Table

MODERN PERIODIC TABLE

GROUPS

- ①. The vertical columns in the periodic table are called groups or families.
- ②. There are nine groups in all including viii group consisting of three triads and zero group of inert gases.
- ③. Groups I to VII are sub-divided into sub-groups A & B.
- ④. Elements of groups IA to group VII A have their outermost shells incomplete while each of their inner shell is complete. These elements are called normal or representative elements. These elements consist of some metals, all non-metals and metalloids.
- ⑤. Elements of groups IB, IIB, IIIB (only Sc, Y, La & Ac), IVB, VB, VIB, VIIB & VIIIB have their two outermost shells incomplete. These are called transition elements. All these are metals.
- ⑥. Elements of zero group have all their shells completely filled. These are noble gases.
- ⑦. Two groups of 14 elements lying in group IIIB [Ce($z = 58$) to Lu($z = 71$) and Th($z = 90$) to Lw($z = 103$)] have their three outmost shells incomplete. There are known as lanthanides and actinides respectively.

PERIODS

- ①. The horizontal rows in the periodic table are called periods.
- ②. There are seven periods in the periodic table.
- ③. First period consist of two elements H & He.
- ④. Second and third periods have 8 elements each.
- ⑤. Second period \longrightarrow from Li to Ne & 3rd period \longrightarrow from Na to Ar both these are short period.
- ⑥. Fourth and fifth periods have 18 elements each.
- ⑦. 4th period \longrightarrow from K to Kr & 5th period \longrightarrow from Rb to Xe. These are long periods.
- ⑧. Sixth period has 32 elements from Ca to Rn. It is the longest period. It also includes 14 lanthanides.
- ⑨. Seventh period is incomplete. This period also includes 14 actinides. The elements after U($z = 92$) are called transuranic elements. These elements are the result of atomic research and hence are synthetic elements.

GENERAL CHARACTERISTICS OF GROUPS

- ①. All the elements of a given group possess very similar chemical and physical properties. These are regular gradation in their properties when we move from top to bottom in a group.
- ②. Size of atoms increases on descending a group.
- ③. The metallic character of the elements increases in moving from top to bottom in a group.
- ④. In going down a group, the number of electron shells increases by one at each step and ultimately becomes equal to the number of the period to which the element belongs.

GENERAL CHARACTERISTICS OF PERIODS

- ①. Number of valency electrons increases from 1 to 8 as we proceed from left to right in a period.
- ②. Size of atoms decreases from left to right in a period.
- ③. From left to right in a period, metallic character of the element decreases.

DIAGONAL RELATIONSHIP

- ①. Diagonal relationship is the resemblance of the properties of the elements of 2nd period with their diagonally opposite members lying in 3rd period.
- ②. Examples of diagonal relationship found in the periodic table are Li - Mg; Be - Al; B - Si.

DIVISION OF ELEMENTS INTO S-, P-, d- & f- BLOCK ELEMENTS

S-BLOCK ELEMENTS

- ①. In the atoms of these elements, the last electron enters the S-orbital of the ultimate shell.
- ②. Valence shell electronic configuration varies from ns^1 to ns^2 .
- ③. Elements of group IA, group IIA and He belongs to this block.

P-BLOCK ELEMENTS

- ①. In the atoms of these elements, the last electron enters the p orbital of the ultimate shell.
- ②. Valence shell configuration varies from $ns^2 np^1$ to $ns^2 np^6$.
- ③. Element of group IIIA, IVA, VA, VIA, VIIA & zero group (Ne to Rn) belong to this block.

d-BLOCK ELEMENTS

- ①. In these elements, either in their atomic state or in any of their common oxidation state, the last electron enter the d-orbital of the penultimate shell i.e. the last electron goes to the $(n-1)$ d-orbital.
- ②. With the exceptions of Cr, Cu, Nb, Mo, Ru, Rh, Pd, Ag, Pt & Au, in the atoms of these elements the ns orbital is completely filled.

Consequently, the valence shell configuration of these elements varies from $(n-1)d^1 ns^2$ (group IIIB) to $(n-1)d^{10} ns^2$ (group IIB) configuration. The elements of groups IIIB, IVB, VB, VIB, VIIB, VIII, IB & IIB belong to this block. These elements are classified into four series i.e. 3d, 4d, 5d & 6d orbitals of 3rd, 4th, 5th & 6th shell respectively.

f-BLOCK ELEMENTS

In these elements, either in their atomic state or in any of their common oxidation state, the last electron enters the f-orbital of ante-penultimate shell.

The valence shell electronic configuration of the atoms of these elements is represented as:

$(n-2)f^{1-14} (n-1)d^{0-1} ns^2$. These elements are located in group IIIB and have been given a separate place at the bottom of the periodic table.

These are classified into two series i.e. 4f and 5f corresponding to the filling of 4f and 5f orbitals of 4th and 5th shells respectively.

EXERCISE

- Q01. The element in which all except the outer most shell is complete is called:
A. d-block elements B. f-block elements
C. normal elements D. none of the above
- Q02. Elements of group IB are called:
A. coinage metals B. rare earth metals
C. normal elements D. transition elements
- Q03. The element Radon belongs to the family:
A. Lanthanide series B. Actinide series
C. Alkali metals D. Noble gases
- Q04. An element of atomic number 24 belongs to:
A. s-block B. p-block
C. d-block D. f-block
- Q05. Ionization energy is lowest for:
A. inert gases B. alkali metals
C. halogens D. alkaline earth metals
- Q06. The ionization energy from Li to Cs:
A. decreases B. increases
C. remain same D. none of the above.
- Q07. "Atomic volumes of elements are periodic functions of their atomic weight". The statement was proposed by:
A. Newland B. Mosely
C. Lothar Meyer D. Dobereiner
- Q08. Number of groups in modern periodic table is:
A. 2 B. 7
C. 9 D. 8
- Q09. The number of elements in fourth long period of modern periodic table is:
A. 8 B. 18
C. 32 D. 10
- Q10. Which of the following ions have noble gas electronic configuration:
A. Zn^{2+} B. Sc^{3+}
C. Cu^+ D. Cu^{2+}
- Q11. The first scientist to publish on the periodic table was:
A. Moseley B. Dalton
C. Gay-Lussac D. Mendeleev
- Q12. The first attempt to classify elements was made by:
A. Dobereiner B. Newland
C. Mendeleev D. Lothar Meyer
- Q13. Which series of outer transition elements is incomplete?
A. Series 3 B. Series 4
C. Series 2 D. Series 1
- Q14. The Valence shell configuration of f-block elements is:
A. $ns^2 (n-1) d^1$
B. $ns^2 (n-1) d^1 (n-2) f^{1-14}$
C. $ns^2 (n-2) f^{1-14}$ D. $ns^2 (n-1) d^{1-10}$
- Q15. In periodic table, the group number corresponds to the total number of electrons in:
A. first shell B. second shell
C. third shell D. Valence shell
- Q16. In second & third period of the periodic table the periodic recurrence of properties takes place after:
A. 8 elements B. 18 elements
C. 10 elements D. 7 elements
- Q17. Which period of the periodic table is known as first very long period?
A. Period 4 B. Period 5
C. Period 6 D. Period 7
- Q18. Typical elements include:
A. only metals B. only non-metals
C. metalloids D. metals, non-metals & metalloids
- Q19. The correct position of I & Te in the Mendeleev's periodic table is that:
A. I precedes Te
B. Te precedes I
C. both occupy same position
D. none of the above
- Q20. The last element of second period is:
A. Hydrogen B. Helium
C. Neon D. Argon
- Q21. Period 5 of the periodic table corresponds to the filling up of:
A. L-shell B. M-shell
C. N-shell D. O-shell

Chemistry
Oxygen is more electronegative than any element given below except:

- A. H
B. N
C. F
D. S

Dobereiner arranged similar elements into groups of three called Triads. One of the triads was:

- A. Li, Na, K
B. Li, Be, K
C. Na, Be, K
D. none of these

According to Mendeleev's periodic table:

- A. Ar should precede K
B. K should precede Ar
C. K & Ar should occupy same position
D. None of the above

The correct increasing order of the electron affinity value of F, Cl, Br and I atoms is:

- A. $I < Br < F < Cl$
B. $I < Cl < F < Br$
C. $I < F < Br < Cl$
D. $F < Cl < Br < I$

The energy released when a neutral gaseous atom picks up an electron is called:

- A. electro negativity
B. electron affinity
C. ionization Potential
D. Solvation energy

As one descends a group in the periodic table, the electro negativity generally:

- A. remains constant.
B. increases
C. decreases
D. increases up to a certain element & then decreases

The correct decreasing order of second ionization potential of C, N, O & F is:

- A. $C > N > O > F$
B. $O > N > F > C$
C. $O > F > N > C$
D. $F > O > N > C$

The ionization potential of inert gases are:

- A. the highest of all metals.
B. the lowest of all metals
C. same as that of other metals
D. none of the above these

The magnitude of electron affinity depends mainly on:

- A. atomic size
B. nuclear charge
C. screening effect
D. all the above three

The atoms which have high value of first ionization potential always have:

- A. large atomic radius
B. low electron affinity
C. tightly bound valence electrons
D. none of the above

For a given value of 'n', the ionization energy is highest for:

- A. d-electrons
B. f-electrons
C. p-electrons
D. s-electrons

Ionization potential of boron is:

- A. greater than Be
B. less than Be
C. equal to Be
D. twice the value of Be

Q34.

The screening effect of d-electron is:

- A. much less than s-electron
B. much more than s-electron
C. equal to s-electron
D. equal to p-electron

Q35.

Size of noble gas atoms can be expressed in terms of their:

- A. covalent radii
B. vander waal radii
C. ionic radii
D. none of the above

Q36.



The removal of an electron from the gaseous atom is best described quantitatively in terms of:

- A. bond energy
B. electronegativity
C. ionization potential
D. electron affinity

Q37.

Who gave the law of octaves?

- A. Dobereiner
B. Lothar Meyer
C. Newlands
D. Mendeleev's

Q38.

Mendeleev's periodic table was based on:

- A. atomic number
B. atomic size
C. atomic volume
D. atomic weight

Q39.

Which of the following statements regarding electro negativity is not correct:

- A. Electronegativity is select to ionization energy.
B. Electronegativity is related to electron affinity.
C. Electronegativity is the power of an atom to attract electrons.
D. Electronegativity is the power of an atom to repel electrons.

Q40.

In the periodic table, the metallic character of elements:

- A. decreases (i) from left to right across a period (ii) & on descending a group.
B. decreases (i) from left to right across a period (ii) & increases on descending a group.
C. Increases from left to right across a period (ii) & increases on descending a group.
D. Increases (i) from left to right across a period (ii) & decreases on descending a group

Q41.

Which one of the following is the lightest metal?

- A. Li
B. Mg
C. Ca
D. Na

Q42.

The electronegativity of B is same as that of:

- A. Mg
B. Al
C. Na
D. none of the above.

Q43.

Which is the most electropositive element?

- A. I
B. Li
C. Cs
D. H

Q44.

The ionization energy of nitrogen is more than that of oxygen, because:

- A. of the extra stability of half filled p-orbital in nitrogen.
B. of the smaller size of nitrogen.
C. the former contains less number of electrons.
D. the former is less electronegative.

- Q45.** Which of the following pairs of elements has chemically similar properties?
 A. V, Cr B. Mn, Fe
 C. B, Al D. Sc, Ti
- Q46.** Which one of the following is the strongest oxidizing agent?
 A. Ozone B. Oxygen
 C. Fluorine D. Chlorine.
- Q47.** Representative elements include:
 A. s and p block elements
 B. s- and zero group elements
 C. p- and d-block elements
 D. s- and d-block elements
- Q48.** The outer atomic shell of an atom has the configuration $3s^2 3p^3$ predict whether it is a:
 A. metal B. non-Metal
 C. metalloid D. inert gas
- Q49.** Elements of 3rd period are called:
 A. typical elements B. transition elements
 C. f-block elements D. s-block elements
- Q50.** Transition elements are those in which the differentiating electron goes into orbital:
 A. ns B. $(n-1)d$
 C. $(n-2)f$ D. np
- Q51.** Elements have been arranged in the modern periodic table in the order of:
 A. increasing atomic weight
 B. increasing atomic number
 C. increasing atomic volume
 D. increasing ionic radius
- Q52.** Elements in the same group of the periodic table have the same:
 A. atomic weight B. atomic number
 C. number of electrons available for bonding
 D. number of electrons
- Q53.** An element belong to group V and period III. The atomic number of the element is:
 A. 7 B. 13
 C. 15 D. 23
- Q54.** The element with atomic number 22 belongs to:
 A. Group III & period 3
 B. Group IV & period 4
 C. Group III & period 4
 D. Period III & group 4
- Q55.** Which, of the following has small atomic radius?
 A. Lithium B. Magnesium
 C. Sodium D. Beryllium
- Q56.** In a period from left to right the valency of elements changes as:
 A. Increases from 1 to 4 & then decreases
 B. Increases from 1
 C. Decreases from 8 D. Dose not change
- Q57.** Among inner transition elements the differentiating electron enters into the orbital.
 A. f B. d
 C. p D. s
- Q58.** An element 'Q' combines with sodium & forms an ionic compound. The element 'Q' belongs to the group:
 A. 0, I B. II, III
 C. IV, V D. VI, VII
- Q59.** Among the following, the substance that has lowest density is:
 A. Na B. Li
 C. Mg D. Ca
- Q60.** Among the following the element possessing highest electronegativity is:
 A. O B. Cl
 C. Br D. I
- Q61.** The unit in which ionization potential is measured:
 A. Curie B. Electron volts
 C. Fermi D. All of these
- Q62.** Basic nature of the oxides of third period from left to right:
 A. decreases B. increases
 C. dose not change D. none of the above
- Q63.** Among the zero group elements, the element that forms many chemical compound is:
 A. He B. Ne
 C. Ar D. Xe
- Q64.** Among alkaline earth metals, the element that forms covalent compound is:
 A. Ca B. Be
 C. Ba D. Sr
- Q65.** Which of the following is the most electro positive?
 A. Calcium B. Carbon
 C. Chlorine D. Potassium
- Q66.** In the long form of periodic table, all the non-metal are placed in:
 A. s-block B. p-block
 C. d-block D. f-block
- Q67.** The first ionization energy of lithium will be:
 A. greater than beryllium
 B. lesser than beryllium
 C. lesser than sodium
 D. equal to magnesium
- Q68.** Which pair of atomic number represents element which are both s-block elements?
 A. 7, 15 B. 6, 12
 C. 9, 19 D. 3, 12
- Q69.** Transition elements exhibit variable valency on account of.
 A. Incompletely filled s-orbitals
 B. Incompletely filled p-orbitals
 C. Incompletely filled d-orbital
 D. none of the above
- Q70.** The electronic configuration of transitional element in +3 state is $(Ar) 3d^4$. Its electronic configuration is:
 A. $(Ar) 3d^7$ B. $(Ar) 4s^2 3d^6$
 C. $(Ar) 4s^1 3d^6$ D. $(Ar) 4s^2 3d^4$

Topic 12

Hydrogen & Water

POSITION OF HYDROGEN IN PERIODIC TABLE

- ①. Hydrogen resembles and at the same time differs from the elements of group IA (alkali metals) and group VIIA (halogens). It also shows some resemblance and also dissimilarities with carbon. Its position in the periodic table remains undecided.
- ②. Hydrogen resembles with alkali metals in the following respects: In electronic configuration, formation of unipositive ion, monovalent, electropositive character, affinity for non-metals and in reducing properties.
- ③. Hydrogen shown dissimilarities with alkali metals in the following respects:
In ionization potential values, ionic radii, nature of oxides.
- ④. Hydrogen resembles halogens in the following respects:
In ionization potential values, atomicity, electronegative character, formation of negative ions, state, formation of covalent compounds and both are non-metals.
- ⑤. Hydrogen shows dissimilarities with halogens in the following respects:
In nature of oxides, valency, affinity for metals.

VARIABLE FORMS OF HYDROGEN

- ①. **Ortho:** It is the molecular hydrogen in which nucleus of both the hydrogen atoms spin in the same direction.
- ②. **Para Hydrogen:** It is the molecular hydrogen in which nucleus of both the hydrogen atoms spin in opposite direction.
- ③. **Ordinary Hydrogen:** At room temperature, it is an equilibrium mixture of 25% para and 75% ortho forms. It is better known as hydrogen gas.
- ④. **Atomic Hydrogen:** Hydrogen at a pressure of 0.01mm or less is passed through tungsten, platinum or palladium at 1000°C to 2000°C to produce atomic hydrogen. (This led to the discovery of atomic hydrogen welding torch).

- ⑤. **Deuterium:** It is the heavier isotope of hydrogen containing one proton and one neutron in the nucleus and one electron revolving around it. It is also known as heavy hydrogen.
- ⑥. **Tritium:** It is another isotope of hydrogen containing one proton and two neutrons in the nucleus and one electron revolving around it. It occurs in nature in very small amount. Its half life period is 12.5 years.
- ⑦. **Nascent Hydrogen:** The hydrogen produced in contact with the substance to be reduced, is known as Nascent hydrogen. It is for more effective in bringing about reduction than molecular hydrogen.
- ⑧. **Heavy Water (D_2O):** Discovered by Urey-an American chemist, who showed that ordinary water contains one part of heavy water in 6000 parts of it.
Heavy water molecule consist of two heavy hydrogen atoms united with one oxygen atom. It may also be named as Deuterium oxide

HARDNESS OF WATER

- ①. Water for washing purposes should be free from the dissolved salts of calcium and magnesium. If these salts are present, they prevent the formation of lather and react with soap forming curdy precipitates.
- ②. Soap is sodium or potassium salt of certain organic acids (like stearic acid, palmitic acid etc). When it comes in contact with calcium or magnesium salts present in water, soap gets wasted and no lather is produced until these particles are removed.
- ③. The water which does not form lather with soap easily, is called hard water.
- ④. The water which forms lather with soap is called soft water. It is free from calcium or magnesium salts.

TYPES OF HARDNESS

- ①. (a). **Temporary Hardness:**
 - ✧ It is due to the presence of bicarbonates of calcium and magnesium.
 - ✧ It can be removed by boiling water or by adding slaked lime due to which soluble bicarbonates are converted into insoluble carbonates and settle down and water becomes soft.
- ②. (b). **Permanent Hardness:**
 - ✧ It is due to the presence of sulphates and chlorides of calcium and magnesium.
 - ✧ It cannot be removed by boiling.

- ◇. It can be removed by adding washing soda.
 - ◇. If temporary and permanent hardness are jointly present, caustic soda is used.
- Modern ion exchange methods for the purification of water enable the removal of all soluble mineral without distillation and water obtained is as good as distilled water.

EXERCISE

- Q01. The maximum number of hydrogen bonds that a water molecule can produce is:
A. 2 B. 1
C. 3 D. 4
- Q02. Water is identified by:
A. adding phenolphthalein
B. testing with little anhydrous CuSO_4
C. testing with blue litmus paper
D. testing with red litmus paper
- Q03. Name of proton in Deuterium is:
A. 1 B. 2
C. 3 D. zero.
- Q04. Electronic configuration of deuterium atom is:
A. $1s^2 2s^0$ B. $1s^1 2s^0$
C. $1s^2 2s^1$ D. $1s^2 2s^2$
- Q05. Percentage of Deuterium in Heavy water is:
A. 22 B. 11.11
C. 44.0 D. 20
- Q06. Ratio of electron, proton & neutron in tritium is:
A. 1:1:1 B. 1:1:2
C. 2:1:1 D. 1:2:1
- Q07. Hardness of water is due to the presence of following dissolved metal salts of:
A. Na, k B. Mg, k
C. Ca, Mg D. Ca, k
- Q08. Temporary hardness of water is due to the presence of dissolved salts of.
A. $\text{Ca}(\text{HCO}_3)$ B. CaCl_2
C. $\text{Ca}(\text{NO}_2)_2$ D. CaSO_4
- Q09. Atoms present in a molecule of heavy water are:
A. $^2\text{H}, ^{16}_8\text{O}$ B. $^1\text{H}, ^{18}_8\text{O}$
C. $^3\text{H}, ^{16}_8\text{O}$ D. $^1\text{H}, ^{16}_8\text{O}$
- Q10. Formula of heavy water is:
A. H_2O B. HO_2
C. D_2O D. DO_2
- Q11. Solubilities of salts in heavy water when compared with the solubilities of substance in water is:
A. more B. equal
C. less D. no comparison

Hydrogen & Water

- Q12. When water contains dissolved calcium chloride, that water is called:
A. Heavy water B. Soft water
C. Salt water D. Hard water
- Q13. The temperature at which heavy water has maximum density is:
A. 1.16°C B. 4°C
C. 0°C D. 11.6°C
- Q14. The HOH angle in H_2O molecule is:
A. 180° B. 120°
C. 109.28° D. 104.5°
- Q15. Hydrogen is not obtained when Zinc reacts with:
A. Cold water B. Dilute HCl
C. Dilute H_2SO_4 D. Hot NaOH (20%)
- Q16. Presence of magnesium bicarbonate in water causes:
A. both permanent & temporary hardness to water
B. temporary hardness to water
C. Permanent hardness to water
D. none of the above
- Q17. Temporary hardness of water can be removed by adding:
A. $\text{Ca}(\text{OH})_2$ B. $\text{Ca}(\text{HCO}_3)_2$
C. $\text{Mg}(\text{HCO}_3)_2$ D. CaCl_2
- Q18. Permanent hardness of water is due to the presence of:
A. Chlorides of calcium & magnesium
B. Sulphate of calcium & magnesium
C. both of these D. none of above
- Q19. Which one is an ionic hydride?
A. MgH_2 B. SiH_4
C. CaH_2 D. AlH_3
- Q20. Beryllium hydride belongs to the class of:
A. Saline hydrides B. Metallic hydrides
C. Interstitial hydrides D. Polymeric hydrides
- Q21. Which one of the following pairs is correctly matched:
A. BaH_2 is a ----- covalent hydride
B. BeH_2 is an ----- Interstitial hydride
C. KH is an ----- ionic hydride
D. all are correct.
- Q22. Which is the heaviest?
A. Deuterium B. Helium
C. Hydrogen D. Tritium
- Q23. How many neutrons are there in protium?
A. 0 B. 1
C. 2 D. 3
- Q24. How many protons are there in deuterium?
A. 3 B. 1
C. 2 D. Zero
- Q25. Which one of the following is radioactive?
A. Deuterium B. Tritium
C. Helium D. Protium

Chemistry

- When water is boiled for some time, it becomes free from:
- Q26. A. both permanent & temporary hardness
B. its heavy water content
C. Permanent hardness only
D. temporary hardness only
- Hydrogen resembles with:
- Q27. A. Alkali metals B. Halogens
C. Both of these D. None of the above
- Covalent hydrides:
- Q28. A. are formed by p-block elements
B. can be prepared by direct combination of elements
C. contain the elements in non-stoichiometric ratios
D. (a) & (b) are correct
- Hydrogen is placed in group IA because:
- Q29. A. It is light gas
B. It has ns^1 configuration
C. It forms hydrides D. It has isotopes
- Hydrogen gains one electron to form H^- ion. In this way it resembles:
- Q30. A. Halogens B. Alkali metals
C. Noble gases D. Carbon family
- Acidified $KMnO_4$ is decolourized by:
- Q31. A. Ordinary hydrogen B. Nascent hydrogen
C. Oxygen D. Nitrogen
- The absorption of hydrogen by platinum (Pt) or palladium (Pd) is called:
- Q32. A. Hydrogenation B. Reduction
C. Dehydration D. Occlusion
- The binary compounds of hydrogen with transition elements are called:
- Q33. A. Ionic hydrides B. Covalent hydrides
C. Metallic hydrides D. Polymeric hydrides
- When edible oil is heated along with hydrogen gas in the presence of Ni catalyst, it is solidified. This process is called:
- Q34. A. Dehydrogenation B. Hydrogenation
C. Hydration D. Dehydration
- Electronegativity value of hydrogen resembles with:
- Q35. A. alkali metals B. halogens
C. carbon family D. alkaline earth metals
- For the following reaction: $CH_3OH + H_2O_{(g)} \xrightarrow{250^\circ C}$ ----- The product formed is:
- Q36. A. $CO_{2(g)} + 3H_{2(g)}$ B. $CO_{(g)} + H_{2(g)}$
C. $3CO_{2(g)} + H_{2(g)}$ D. $CO_{2(g)} + N_{2(g)}$
- $CuO + H_2 \longrightarrow Cu + H_2O$
- The above reaction shows which property of hydrogen:
- Q37. A. as an oxidizing agent B. as a reducing agent
C. as an acid D. none of above
- From water gas, carbon monoxide can be removed by cooling water gas at ----- °C with the help of liquid air:
- Q38. A. -50°C B. -100°C
C. -252°C D. -200°C
- The product obtained as a result of dissociation of molecular hydrogen is:
- Q39. A. Ordinary hydrogen B. Nascent hydrogen
C. Atomic hydrogen D. All of these
- Hydrogen set free at the time of its preparation from its compounds is in atomic form & commonly known as:
- Q40. A. Molecular hydrogen B. Nascent hydrogen
C. Atomic hydrogen D. Ordinary hydrogen
- $H + H \longrightarrow H_2 + \text{-----}$ The bond formation energy for above reaction is:
- Q41. A. 50 Kcal mol^{-1} B. 101 Kcal mol^{-1}
C. 104 Kcal mol^{-1} D. 150 Kcal/mole
- Atom of which element loses its only valency electron forming a bare proton?
- Q42. A. Helium B. Hydrogen
C. Halogen D. none of these
- Hydrogen resembles with alkali metals in the sense that:
- Q43. A. both are electronegative B. both are electropositive
C. their halides produce anions in water
D. they have equal electronegativity values
- Which of the following statement is not correct:
- Q44. A. Hydrogen is a very good reducing agent
B. In metallic hydrides, hydrogen exhibits -1 oxidation state
C. Hydrogen exists as diatomic molecule same as alkali metals
D. Hydrogen is active in atomic form
- A mixture of carbon monoxide & hydrogen is known as:
- Q45. A. CO_2 B. Water gas
C. Producer gas D. Coal gas
- When steam is passed over red hot coke at 1000 °C, the product is:
- Q46. A. $CO_{(g)}$ B. $H_{2(g)}$
C. Water gas D. CO_2
- Isotopes of hydrogen differ from each other only in their:
- Q47. A. Chemical properties B. Physical properties
C. Chemical & physical properties both
D. none of these
- As compared to alkali metals; ionization potential of hydrogen is:
- Q48. A. Low B. Very low
C. Very high
D. Same as that of alkali metals.

- Q49.** The point of similarity between hydrogen & carbon is that:
 A. both are gases
 B. both have their outer most orbitals half filled
 C. both are univalent
 D. both exist in diatomic form
- Q50.** Which of the following statements is not correct for Nascent hydrogen:
 A. It is in the form of atomic condition
 B. It is generated in the form of small bubbles under high pressure
 C. It is associated with very high energy
 D. Its bond energy is 431 KJ/mole
- Q51.** Hydrogen is industrially manufactured by passing steam over red hot coke. This method is known as:
 A. Bosch process B. Lane's process
 C. Haber's process D. Contact process
- Q52.** Commercial hydrogen can be obtained by the action of steam on:
 A. Coal gas B. Producer gas
 C. Marsh gas D. Water gas
- Q53.** The catalyst used in Bosch process for manufacture of hydrogen is:
 A. V_2O_5 B. $Fe_2O_3 + Cr_2O_3$
 C. Pd D. Finally divided iron.
- Q54.** A hydride ion & helium atom have the same:
 A. number of protons
 B. number of electrons
 C. number of neutrons
 D. Valency
- Q55.** When electricity is passed through water containing a little acid, it liberates hydrogen, which is collected:
 A. at anode B. at cathode
 C. Over the surface of water
 D. none of the two electrodes

Topic 13

Group IA Elements (Alkali Metals)

- ⊗ This group includes Lithium, Sodium, Potassium, Rubidium, Caesium, and Francium.
- ⊗ These elements are collectively called alkali metals since they form strong alkaline oxides and hydroxides.
- ⊗ Fr is a radioactive element.
- ⊗ With the exception of Li, alkali metals are extremely soft and readily fused.
- ⊗ These are highly malleable and ductile.
- ⊗ From Li to Cs, there is an increase of atomic & ionic radii.
- ⊗ Melting and boiling points are very low because of the presence of weak interatomic bonds in the solid state of alkali metals.
- ⊗ Alkali metals have low ionization energies. Ionization energy goes on decreasing from Li to Cs.
- ⊗ These elements show strong electropositive or metallic character.
- ⊗ They act as strong reducing agents.
- ⊗ Alkali metals are good conductors of electricity and heat.
- ⊗ Lithium salts are strongly covalent while other alkali metal salts are ionic.
- ⊗ Alkali metals react with O_2 or air rapidly and thus get tarnished due to the formation of their oxide on the surface of metals.
- ⊗ Alkali metal hydroxides are crystalline solids. These are ionic compounds, highly soluble in water and alcohol. The basic character of their hydroxides increases from LiOH to CsOH.
- ⊗ Alkali metals dissolve readily in mercury and form amalgams.

EXERCISE

- Q01. Alkali metals are highly reactive, because of:
- A. +1 oxidation state
 - B. high electropositive character
 - C. high electron affinity
 - D. ns^1 electronic configuration

- Q02. Na & K are kept in:
- A. Absolute alcohol
 - B. Petrol
 - C. Kerosine oil
 - D. CCl_4
- Q03. Li reacts with water less vigorously than Na, because:
- A. It has low atomic number
 - B. Li has $1s^2 2s^1$ electronic configuration
 - C. Li is less electropositive
 - D. Na has higher atomic weight
- Q04. Electrical conductivity of Cs^+ is greater than Li^+ ion, because
- A. Li^+ ion becomes highly hydrated
 - B. Cs^+ ion becomes highly hydrated
 - C. Cs^+ ion is least hydrated
 - D. Li^+ ion is least hydrated
- Q05. Which has minimum hydration energy?
- A. Na^+
 - B. K^+
 - C. Rb^+
 - D. Cs^+
- Q06. The radii of hydrated cation, $M^+_{(aq)}$ decreases in the order,
 $Li^+ > Na^+_{(aq)} > K^+_{(aq)} > Rb^+_{(aq)} > Cs^+_{(aq)}$
 This order is due to the fact that:
- A. the degree of hydration of M^+ cations decreases from Li^+ to Cs^+
 - B. the degree of hydration of M^+ cations increases from Li^+ to Cs^+
 - C. the charges on the cations remains the same
 - D. none of the above
- Q07. Which one of the following alkali metals does not form alum?
- A. Li
 - B. Na
 - C. K
 - D. none of these
- Q08. Sodium burns in air to give:
- A. Sodium hydroxide
 - B. Sodium oxide
 - C. Sodium peroxide
 - D. Sodium super oxide
- Q09. Which of the following statements regarding alkali metals is not correct:
- A. They are very reactive
 - B. They belong to s-block
 - C. Their hydroxides are alkaline in nature
 - D. Their electronic configuration is ns^2
- Q10. Which one of the following has a polarizing power close to that of magnesium?
- A. Li
 - B. Na
 - C. K
 - D. Rb
- Q11. The most abundant salt of sodium is its:
- A. Nitrate
 - B. Chloride
 - C. Sulphate
 - D. Phosphate
- Q12. The reaction of water with sodium is:
- A. endothermic
 - B. exothermic
 - C. reversible
 - D. Very slow
- Q13. Alkali metals differ from coinage metals in the electronic configuration of their:
- A. Inner most shell
 - B. Outer most shell
 - C. Penultimate shell
 - D. none of these

- Q14. Which one of the following is not the electronic configuration of an alkali metal?
 A. $[Ar] 3d^{10} 4s^1$ B. $[Kr] 5s^1$
 C. $[Xe] 6s^1$ D. $[Rn] 7s^1$
- Q15. Which one of the following alkali metals has the highest density?
 A. Li B. Na
 C. Rb D. Cs
- Q16. Sodium amalgam is used as:
 A. Oxidizing agent B. Reducing agent
 C. Catalyst D. Bleaching agent
- Q17. Which of the following reacts most vigorously with water?
 A. Na B. K
 C. Cs D. Rb
- Q18. Alkali metals show typical characteristics of:
 A. Inner transition elements
 B. Noble gases
 C. Transition elements
 D. Representative element
- Q19. Which of the following alkali metals is the most abundant in earth's crust?
 A. Lithium B. Potassium
 C. Rubidium D. Sodium
- Q20. Alkali metals give colour in Bunsen flame due to:
 A. Low ionization potential
 B. Low melting point
 C. Softness
 D. One electron in outer most orbit
- Q21. Among the alkali metals, the metal with the highest ionization potential is:
 A. Sodium B. Lithium
 C. Rubidium D. Cesium
- Q22. In the long form of periodic table, the elements having lowest ionization potential are present in:
 A. I group B. IV group
 C. VII group D. Zero group
- Q23. In Castner-kellner process used in the preparation of NaOH, cathode in the middle compartment is:
 A. C B. Pt
 C. Hg D. Fe
- Q24. $M_{(s)} \longrightarrow M^+_{(aq)} + e^-$, the alkali metal which has highest tendency for this reaction is:
 A. Li B. K
 C. Cs D. Na
- Q25. When Li burns in the excess of O_2 , it forms:
 A. normal oxide B. Peroxide
 C. Superoxide D. dioxide
- Q26. When Na burns in excess of O_2 , it forms:
 A. Super oxide B. Peroxide
 C. Monoxide D. dioxide

Group IA Elements (Alkali Metals)

- Q27. When alkali metals are dissolved in liquid NH_3 , a blue coloured solution is obtained. The blue colour of the solution is due to the formation of:
 A. ammoniated M^+ cation
 B. ammoniated electrons
 C. ammoniated NH_2^- ions
 D. ammoniated protons
- Q28. Metallic Cs has lower melting point than metallic Li, because metallic Cs:
 A. has smaller atomic radius
 B. has lower atomic weight
 C. has weaker bonding forces
 D. is more reactive
- Q29. When Na is heated in flame, it will give:
 A. Golden yellow colour
 B. Crimson red colour
 C. Brick red colour
 D. Violet colour
- Q30. Alkali metals are powerful reducing agents, because:
 A. these are metals
 B. these are monovalent
 C. their ionic radii are large
 D. their ionization potentials are low
- Q31. Alkali metal halides are ionic in nature with the exception of the halides of:
 A. Cs B. Li
 C. Rb D. K
- Q32. LiCl show covalent character, because:
 A. Cl^- ion is strongly polarized by Li^+ ion
 B. Cl^- ion is not polarized by Li^+ ion
 C. LiCl is not able to give Li^+ & Cl^- ions
 D. Li^+ ion is large & Cl^- ion is small
- Q33. Which of the following is used in the preparation of Na_2CO_3 ?
 A. Slaked lime B. Quick lime
 C. Lime stone D. NaOH
- Q34. Chile salt peter is:
 A. $NaNO_3$ B. Na_2SO_4
 C. KNO_3 D. $Na_2S_2O_3$
- Q35. Which of the following has greater hydration energy than the Mg^{+2} ion:
 A. Al^{+3} B. Na^+
 C. Be^{+2} D. B^{+3}
- Q36. Oxides of alkaline earth metals are less basic than the oxides of alkali metals. The reason is:
 A. alkali metals form ionic bond
 B. alkali metals have more affinity for oxygen.
 C. electropositive nature of alkali metals is more than alkaline earth metals.
 D. electropositive nature of alkali metals is less than alkaline earth metals.

Chemistry

Q37. Alkali metal
 A. Alloy
 C. Intermet
 D. Allotrop
 Which of the

Q38. Na
 A. Na
 C. Li
 Which of the

Q39. Li_2O
 A. Li_2O
 C. MgO

Q40. Which of the
 ionic?
 A. NaCl
 C. $MgCl_2$
 Which of the

Q41. lime?
 A. Na_2CO_3
 C. NaOH +

Chemistry

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- Q42. Alkali metals combine with mercury to form:
 A. Alloy B. Amalgams
 C. Intermetallic compounds
 D. Allotropes
- Q43. Which of the following is more reactive?
 A. Na B. K
 C. Li D. Mg
- Q44. Which of the following is the most basic?
 A. Li_2O B. Na_2O
 C. MgO D. BeO
- Q45. Which of the following chloride is the most ionic?
 A. $NaCl$ B. $CsCl$
 C. $MgCl_2$ D. $BaCl_2$
- Q46. Which of the following mixture indicates soda lime?
 A. $Na_2CO_3 + CaO$ B. $NaOH + NaHCO_3$
 C. $NaOH + CaO$ D. $NaOH + Na_2CO_3$

- Q42. Baking soda is represented by the formula:
 A. $NaHCO_3$ B. Na_2CO_3
 C. $NaHSO_4$ D. $NaOH$
- Q43. Radioactive element among alkali metals is:
 A. Radium B. Radon
 C. Francium D. Rubidium
- Q44. Fused $NaCl$ is used for electrolysis because:
 A. aqueous $NaCl$ solution cannot be electrolysed
 B. aqueous $NaCl$ solution, if electrolyzed, gives sodium which further react with water to form sodium hydroxide.
 C. it becomes covalent in the fused state.
 D. it melts at a very low temperature.
- Q45. Which of the following can be obtained by electrolytic process:
 A. Sodium B. Sodium hydroxide
 C. Aluminium D. All of these

Topic 14
Group IIA Elements
(Alkaline Earth Metals)

- ④. Group IIA of the periodic table consists of six elements, which are Beryllium, Magnesium, Calcium, Strontium, Barium, and Radium.
- ④. The oxides of three metals i.e. *Ca*, *Sr* and *Ba* were known much earlier than the metals themselves and were called alkaline earths since they were alkaline in nature and occurred in nature as earths [lime (CaO), Strontia (SrO) & baryta (BaO)].
- ④. Radium is radioactive element.
- ④. General valence shell electronic configuration is ns^2 .
- ④. Melting and boiling points of these elements do not show any regular trend.
- ④. The first and second ionization energies of these elements decrease with the increase of atomic radii from *Be* to *Ba*.
- ④. Alkaline earth metals are good conductors of heat & electricity.
- ④. These are weaker reducing agents than alkali metals.
- ④. They form normal oxides, which are obtained by heating the metal in O_2 or by heating their carbonates at high temperature.
- ④. These oxides are extremely stable white crystalline solids due to their high crystal lattice energy.
- ④. Due to small size of Be^{2+} ion, BeO is covalent while other oxides are ionic.
- ④. *Be* shows diagonal relationship with *Al*.

EXERCISE

- Q01.** Which one of the following is not an alkaline earth metal?
- A. *Ca*
B. *Sr*
C. *Rb*
D. *Ra*
- Q02.** Alkaline earth metals (group IIA) elements differ from group IIB elements in the electronic configuration of their:
- A. Inner most shell
B. Penultimate shell
C. Outer most shell
D. Valence shell

- Group IIA**
- Q03. Which one of the following is the electronic configuration of an alkaline earth metal?
A. $[Ne] 3S^2$ B. $[Ar] 3d^{10}, 4S^1$
C. $[Kr] 4d^{10}, 5S^2$ D. $[Xe] 4f^{14}, 5d^{10}, 6S^2$
- Q04. The correct sequence of alkaline earth metals in the group is:
A. Ba, Mg, Ca, Sr, Be, Ra
B. Be, Mg, Ca, Sr, Ba, Ra
C. Mg, Ba, Ca, Sr, Be, Ra
D. Mg, Be, Ca, Sr, Ba, Ra
- Q05. Which one of the following alkaline earth metals shows anomalous behaviour in its subgroup?
A. Be B. Mg
C. Sr D. Ba
- Q06. Which of the following metals show diagonal relationship with aluminium?
A. Be B. Ca
C. Sr D. Ba
- Q07. Which one of the following alkaline earth metals is present in chlorophyll?
A. Be B. Mg
C. Ca D. Ba
- Q08. Which of the following alkaline earth metal hydroxides is the least soluble?
A. $Mg(OH)_2$ B. $Ba(OH)_2$
C. $Be(OH)_2$ D. $Sr(OH)_2$
- Q09. Which one of the following composition represents plaster of Paris?
A. $CaSO_4$ B. $CaSO_4 \cdot 1/2 H_2O$
C. $CaSO_4 \cdot 2H_2O$ D. $CaSO_4 \cdot H_2O$
- Q10. These metals which occur in nature as silicate minerals & their oxides are alkaline are called:
A. Alkali metals B. Alkaline earth metals
C. Rare earth metal D. Transition metal
- Q11. Ionization Potential value of group II when compared with IA is:
A. lesser B. greater
C. equal D. none of the above
- Q12. Which of the following does not impart any colour to the flame:
A. Be & Mg B. Na & K
C. Ca, Sr & Ba D. none of the above
- Q13. The element whose electronic configuration is $1S^2, 2S^2, 2P^6, 3S^2$ is:
A. an alkali metal B. an alkaline earth metal
C. a non-metal D. a noble gas
- Q14. Which of the following is least soluble in water?
A. $CaSO_4$ B. $MgSO_4$
C. Na_2SO_4 D. $BaSO_4$

- Q16. Bleaching powder is made from
A. CaCl_2
B. CaOCl_2
C. CaCl_2 and H_2O
D. CaCl_2 and H_2O_2
- Q17. Epsom salt is
A. Calcium sulphate
B. Magnesium sulphate
C. Ferrous sulphate
D. Ferrous sulphate
- Q18. The substance which is not a salt is
A. Caustic soda
B. Bleaching powder
C. Na_2CO_3
D. NaCl
- Q19. The formula of bleaching powder is
A. CaCl_2
B. CaOCl_2
C. KCl.MgO
D. CaCl_2 and H_2O_2
- Q20. The most common alkaline earth metal is
A. Be
B. Mg
C. Ca
D. Sr
- Q21. Mg^{2+} ion is
A. larger than Mg atom
B. smaller than Mg atom
C. equal to Mg atom
D. none of these
- Q22. The weaker base is
A. Mg(OH)_2
B. Ca(OH)_2
C. NaOH
D. KOH
- Q23. Select the correct statement
A. CaF_2 is a salt
B. BaSO_4 is a salt
C. Ba(OH)_2 is a base
D. MgSO_4 is a salt
- Q24. Which of the following is not a salt
A. BaF_2
B. CaF_2
C. CaF_2
D. CaF_2

- Q15. The mineral carnallite contains magnesium & another metal:
 A. Sodium B. Calcium
 C. Potassium D. Rubidium
- Q16. Bleaching powder is generally expressed as:
 A. CaCl_2 B. CaSO_4
 C. CaOCl_2 D. CaO
- Q17. Epsom salt is a hydrate of:
 A. Calcium sulphate
 B. Magnesium sulphate
 C. Ferrous sulphate
 D. Ferrous ammonium sulphate
- Q18. The substance used for sterilization of water is:
 A. Caustic soda B. Baking soda
 C. Bleaching powder D. Gypsum
- Q19. Formula of Dolomite is:
 A. CaCl_2 B. MgCO_3
 C. $\text{KCl.MgCl}_2.6\text{H}_2\text{O}$ D. $\text{MgCO}_3.\text{CaCO}_3$
- Q20. The most electropositive element among the alkaline earth metals is:
 A. Be B. Mg
 C. Ca D. Ba
- Q21. Mg^{2+} ion is _____ than Na^+ ion:
 A. larger B. smaller
 C. equal D. almost equal
- Q22. The weaker base is:
 A. $\text{Mg}(\text{OH})_2$ B. $\text{Ca}(\text{OH})_2$
 C. NaOH D. KOH
- Q23. Select the correct statement:
 A. CaF_2 is soluble in H_2O
 B. BaSO_4 is soluble in H_2O
 C. $\text{Ba}(\text{OH})_2$ is soluble in H_2O
 D. MgSO_4 is soluble in H_2O
- Q24. Which of the following is the least soluble?
 A. BaF_2 B. SrF_2
 C. CaF_2 D. MgF_2
- Q25. Among the alkaline earth metal sulphates, the soluble sulphates are given by:
 A. Be, Mg B. Be, Ba
 C. Mg, Ba D. Ba, Ca
- Q26. The correct increasing order of the heat of hydration of alkaline earth metal cations is:
 A. $\text{Ba}^{2+} < \text{Sr}^{2+} < \text{Ca}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$
 B. $\text{Ba}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Mg}^{2+} < \text{Be}^{2+}$
 C. $\text{Be}^{2+} < \text{Ba}^{2+} < \text{Sr}^{2+} < \text{Ca}^{2+} < \text{Mg}^{2+}$
 D. $\text{Be}^{2+} < \text{Mg}^{2+} < \text{Ca}^{2+} < \text{Sr}^{2+} < \text{Ba}^{2+}$
- Q27. Which of the following is the most soluble:
 A. MgSO_4 B. SrSO_4
 C. BaSO_4 D. CaSO_4
- Q28. The most probable reason that alkaline earth metals form dipositive ions instead of unipositive ions is:
 A. the values of their first & second ionization potentials are not very much different.
 B. the compounds of unipositive cations of these metals are not stable
 C. the compounds of dipositive ions have more lattice energy than those of unipositive ions
 D. the dipositive ions have more charge on them than the unipositive ions
- Q29. The reaction with cold water is vigorous for alkaline earth metals with the exception of:
 A. Mg B. Be
 C. Ca D. Ba
- Q30. Which of the following has the maximum hydration energy?
 A. Be^{2+} B. Mg^{2+}
 C. Ca^{2+} D. Sr^{2+}

Topic 15

Group IIIA Elements (Boron Family)

- Ⓐ Group IIIA of the periodic table consists of five elements, which are Boron, Aluminium, Gallium, Indium, Thallium.
- Ⓐ In B and Al, penultimate shells have inert gas type configuration.
- Ⓐ Ga, In and Tl whose penultimate shells have pseudo inert gas type configuration.
- Ⓐ Melting points decrease from B to Ga and then increase upto Tl.
- Ⓐ The ionization energy decreases from B to Al, but in going from Al to Ga, the value of ionization energy increases.
- Ⓐ Boron atom gives mainly covalent compounds.
- Ⓐ Electropositive (metallic) character of the elements increases as we move from B to Tl.
- Ⓐ $B(OH)_3$ and B_2O_3 are acidic in character. The oxides and hydroxides of Al^{3+} and Ga^{3+} are amphoteric. The hydroxides and oxides of In^{3+} and Tl^{3+} are distinctly basic.
- Ⓐ Boron trihalides exist as discrete species (i.e. monomeric molecules) while trihalides of other elements exist as dimers both in vapour state and in non-polar solvents.
- Ⓐ The trihalides of all the elements of this group act as Lewis acids. The Lewis acidity is in the order:
 $B > Al > Ga > In$
- Ⓐ None of the elements of this group reacts directly with H_2 to form hydrides. Hydrides of these elements have been prepared by indirect methods.
- Ⓐ Boron shows diagonal relationship with Silicon.

EXERCISE

- Q01. The most abundant element among the following in earth's crust is:
A. Iron B. Aluminium
C. Copper D. Indium
- Q02. Lithium does not form alum, because:
A. electropositive nature is more
B. Small atomic radius
C. ionisation potential is more
D. Possess only one electron in the valence shell

Group IIIA Elements (Boron Family)

- Q03. In the extraction of 'Al' from bauxite by electrolysis 'Cryolite' is useful because:
A. more pure Al is obtained
B. act as a reducing agent
C. Bauxite melts more easily
D. Protects the electrodes
- Q04. Which of the following is called 'Alum'?
A. $NaAlO_2$
B. $FeSO_4 \cdot (NH_4)_2 \cdot SO_4 \cdot 6H_2O$
C. $KCl \cdot MgCl_2 \cdot 6H_2O$
D. $Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
- Q05. Which of the following oxide is Amphoteric?
A. Na_2O
B. Al_2O_3
C. MgO
D. CaO
- Q06. Which of the following is the formula of Borax?
A. $Na_2B_4O_7 \cdot 4H_2O$
B. $Na_2B_4O_7$
C. $Ca_2B_2O_{11} \cdot 5H_2O$
D. $Na_2B_4O_7 \cdot 10H_2O$
- Q07. $AlCl_3$ is a Lewis acid because it:
A. donate electron pair
B. accepts electron pair
C. liberates H_2 with acids
D. accepts hydrogen
- Q08. Al does not react with dil H_2SO_4 as an protective layer is formed. The layer is of:
A. $Al_2(SO_4)_3$
B. $Al(NO_3)_3$
C. Al_2O_3
D. $Al_2(CO_3)_3$
- Q09. Electropositive nature from Aluminium to Boron:
A. decrease
B. increase
C. does not alter
D. none of the above
- Q10. Electrons present in penultimate shell of boron are:
A. 2
B. 8
C. 6
D. 3
- Q11. In the electrolytic refining of metals, pure metal sheet is used as:
A. Cathode
B. Anode
C. both anode & cathode
D. none of the above
- Q12. Ammonium nitrate & Aluminium powder mixture is called:
A. Duralumen
B. Ammonal
C. Carnallite
D. Alum
- Q13. In Hall's electrolytic reduction of Al_2O_3 , the anodic product is:
A. AlF_3
B. Na
C. CO_2
D. Al
- Q14. Purification of 'Al' is done by:
A. Hoope's process
B. Baeyer's process
C. Serpeck's process
D. Hall's process
- Q15. The molecular formula of cryolite is:
A. $NaAlF_3$
B. AlF_3
C. $Al_2(SO_4)_3$
D. $AlCl_3$

- Q16. Bauxite is a mineral used for the extraction of:
 A. Ca B. Cu
 C. Al D. Fe
- Q17. Al^{3+} has lower ionic radius than Mg^{2+} ion because:
 A. Mg has lesser number of neutrons than Al
 B. Al^{3+} has a higher nuclear charge than Mg^{2+}
 C. Their electro negativities are different
 D. Al has a lower ionization potential than Mg atom
- Q18. An elements 'R' is in III group, which is true in respect of 'R':
 A. It is a gas at room temperature
 B. It has an oxidation state of +4
 C. It forms an oxide of the type R_2O_3
 D. It form a halide of the type RX_2
- Q19. An aqueous solution of borax is:
 A. a bleaching agent B. acidic
 C. alkaline D. neutral
- Q20. Alum is a:
 A. basic salt B. Complex
 C. Chelates D. double salt
- Q21. Which one is metaboric acid:
 A. HBO_2 B. H_3BO_3
 C. $H_2B_4O_7$ D. B_2O_3
- Q22. The inert pair effect is most prominent in:
 A. B B. Al
 C. Ga D. Tl
- Q23. Which one of the following resembles silicon in some of its properties?
 A. Boron B. Gallium
 C. Indium D. Thallium
- Q24. Boron halides are:
 A. electron-deficient compounds
 B. ionic compounds
 C. Lewis bases
 D. Used as refractory compound
- Q25. Which one of the following is Potash alum?
 A. $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 12H_2O$
 B. $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
 C. $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$
 D. $(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
- Q26. The cathode used in the electrolytic cell for the production of aluminium is made up of:
 A. Aluminium B. Carbon lining
 C. Iron D. Steel
- Q27. Which of the following elements has the highest melting point:
 A. B B. Al
 C. Ga D. Tl
- Q28. The number of electrons in the outer most orbit of III-A group elements is:
 A. 4 B. 3
 C. 5 D. 6
- Q29. B_2O_3 is:
 A. Acidic B. Basic
 C. Amphoteric D. Ionic
- Q30. When orthoboric acid is heated to red heat, the residue obtained is of:
 A. Boron B. Pyroboric acid
 C. Boric oxide D. Metaboric acid
- Q31. The power of the tri halides of boron to act as Lewis acid decreases in the order:
 A. $BF_3 > BCl_3 > BBr_3$
 B. $BBr_3 > BCl_3 > BF_3$
 C. $BCl_3 > BF_3 > BBr_3$
 D. $BCl_3 > BBr_3 > BF_3$
- Q32. The stability of monohalides of group IIIA elements:-
 A. decreases down the group
 B. increases down the group
 C. first increases & then decreases
 D. first decreases & then increases
- Q33. Which of the following statement regarding BF_3 is not correct?
 A. It is an electron-deficient compound
 B. It is a Lewis acid
 C. It is an ionic compound D. All are correct
- Q34. The total number of elements in six sub-groups of p-block is:
 A. 10 B. 20 C. 30 D. 40
- Q35. Which is not a mineral of Aluminium:
 A. Bauxite B. Diaspore
 C. Corundum D. Malachite
- Q36. Which is the chief ore of Aluminium:
 A. Corundum B. Bauxite
 C. Cryolite D. Diaspore
- Q37. Al reacts with N_2 to form:
 A. AlN B. Al_2N
 C. Al_2N_3 D. Al_2N_6
- Q38. Crude form of Borax is called:
 A. Alum B. Suhaga
 C. Boric acid D. Sandhur
- Q39. The general electronic configuration of p-block elements may be represented as:
 A. ns^1, ns^2 B. ns^2, np^6
 C. ns^2, ns^{1-6} D. $(n-1)ns^2 np^6$
- Q40. In the electrolysis of Alumina, Cryolite, Na_3AlF_6 is added to:
 A. remove impurities
 B. raise the melting point of alumina
 C. increase the electrical conductivity of electrolyte
 D. minimize the volatilization of the electrolyte
- Q41. Which of the processes is used for the purification of bauxite ore containing excess of silica, SiO_2 as impurity:
 A. Hall's process B. Serpeck's process
 C. Baeyer's process D. Hoope's process

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- Q42. In the purification of bauxite by Hall's process, the bauxite ore is:
 A. heated with NaHCO_3
 B. heated with NaOH solution
 C. fused with Na_2CO_3
 D. heated with carbon at 1800°C in the current of nitrogen
- Q43. The maximum capacity of electron accommodation of Boron is:
 A. 5
 B. 6
 C. 8
 D. 18
- Q44. The value of electronegativity & ionization potential decreases down the group in all p-block elements except group:
 A. III-A
 B. IV-A
 C. VII-A
 D. Zero group
- Q45. All members of group III-A are metals except:
 A. Aluminium
 B. Boron
 C. Indium
 D. Barium
- Q46. By the action of sulphuric acid on hot solution of borax, the product formed is:
 A. Boric acid
 B. Meta boric acid
 C. Pyro boric acid
 D. Ortho boric acid
- Q47. Meta boric acid changes to pyroboric acid at:
 A. 100°C
 B. 140°C
 C. 150°C
 D. 1000°C
- Q48. $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$ is the chemical formula of:
 A. Cryolite
 B. Colemanite
 C. Bauxite
 D. Borax
- Q49. When boric acid is reacted with NaOH or Na_2CO_3 , the product formed is:
 A. Metaboric acid
 B. Pyroboric acid
 C. Borax
 D. Boric acid
- Q50. Which statement is true for Borax?
 A. It is insoluble in water
 B. It is soluble in water & forms neutral solution
 C. It is soluble in water & forms an acidic solution
 *D. It is soluble in water & forms an alkaline solution
- Q51. Corundum is an ore of Aluminium represented by:
 A. $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$
 B. $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$
 C. Al_2O_3
 D. Na_3AlF_6
- Q52. When finely divided bauxite is fused with sodium carbonate, it dissolves to form:
 A. Al_2O_3
 B. NaAlO_2
 C. Both of them
 D. None of them
- Q53. $\text{Al}_2\text{O}_3 \cdot n\text{H}_2\text{O} + 2\text{NaOH} \longrightarrow 2\text{NaAlO}_2 + 2(n)\text{H}_2\text{O}$
 The above equation shows which method for the purification of bauxite?
 A. Hall's method
 B. Baeyer's method
 C. Serpeck's method
 D. None of the above
- Q54. In the electrolysis of pure alumina, the electrolyte consists of:
 A. NaAlO_2
 B. AlN
 C. Pure alumina
 D. Alumina dissolved in fused cryolite & fluorspar
- Q55. Aluminium is made passive by:
 A. HCl
 B. H_2SO_4
 C. HNO_3
 D. None of these
- Q56. When aluminium is heated with carbon up to 2000°C , it forms aluminium carbide whose formula is:
 A. AlC_3
 B. Al_3C
 C. Al_4C_3
 D. Al_3C_4
- Q57. Following reaction represents which property of Aluminium:
 $2\text{Fe} + \text{Al}_2\text{O}_3$
 A. As an oxidizing agent
 B. As a reducing agent
 C. As a salt
 D. None of these
- Q58. Which of the following statements is not correct for the process of electrolysis of pure alumina:
 A. Cryolite lowers the melting point of alumina
 B. Fluorspar increases the fluidity of the melt
 C. Cryolite increases the melting point of alumina
 D. When electric current is passed through electrolyte, aluminium is obtained at cathode in liquid state
- Q59. The Aluminium obtained by the electrolysis of Alumina is:
 A. 80% pure
 B. 90% pure
 C. 99% pure
 D. 100% pure
- Q60. Aluminium bronze is an alloy that contains:
 A. 10%Al & 90%Cu
 B. 10%Al, 20%N & 70%Cu
 C. 95%Al, 4%Cu, 0.5%Mg & 0.5%N
 D. 90%Al, 9%Cu & 1.0%N

Group IIIA Elements (Boron Family)

Group (Ca)

Group IVA elements, C, Lead.
 Carbon is the only element that occurs in free form. Excepting P, all show allotropy. The first two are metals, (Si, Ge) are metalloids and distinctly metallic. Melting and boiling points are high for the group but not for the order. All the elements form a strong link with each other, identical at all angles. Catenation. Carbon has the highest melting point. All elements are covalent in nature. Except Carbon, all are attacked by H_2 .

Q01. Which characteristic property of Carbon?

A. It forms a long chain.

B. Its ionization potential is high.

C. It is a non-metal.

D. It is a metal.

Q02. Silicon is a metalloid.

A. Al

C. B

Producer of

A. CO

C. CO

Topic 16

Group IVA Elements
(Carbon Family)

- Group IVA of the periodic table consists of five elements, Carbon, Silicon, Germanium, Tin and Lead.
- Carbon is the only element of this group, which occurs in free state as diamond, graphite and coal.
- Excepting *Pb*, all the other elements of this group show allotropy.
- The first two elements *C* & *Si* are distinctly non-metals, (*Si* also behave as metalloid), *Ge* is a metalloid and the last two elements *Sn* and *Pb* are distinctly metals.
- Melting and boiling point decrease down the group but not in a regular order.
- Ionization energy values decrease on moving down the group from *C* to *Pb* but not in a regular order.
- All the elements of this group have a tendency to link with each other and thus form long chains of identical atoms. This type of linking is called Catenation.
- Carbon has the maximum tendency of Catenation.
- All elements of group IVA form hydrides, covalent in nature.
- Except Carbon, all other elements of this group are attacked by caustic alkalis with evolution of H_2 .

EXERCISE

- Q01. Which one of the following is not a characteristic property of carbon?
- It forms compounds with multiple bonds
 - Its ionization energy is very high
 - It undergoes catenation
 - It undergoes inert pair effect
- Q02. Silicon is diagonally related to:
- Al
 - Be
 - B
 - C
- Q03. Producer gas is essentially a mixture of:
- CO & CH_4
 - CO & N_2
 - CO & H_2
 - H_2 & C_2H_2

- Q04. Diamond & graphite:
- are isotopes of Carbon
 - are Allotropes of Carbon
 - have identical crystal structure
 - have the same degree of harness
- Q05. Which one of the following has the maximum catenation ability?
- Carbon
 - Lead
 - Silicon
 - none of these
- Q06. Which is litharge?
- PbO
 - Pb_3O_4
 - PbO_2
 - $PbO_2 \cdot 2PbO$
- Q07. The most reactive allotropic form of carbon is:
- Diamond
 - Graphite
 - Charcoal
 - Lamp black
- Q08. Which of the following solid substance conducts electricity?
- Carbon
 - Silicon
 - Graphite
 - Diamond
- Q09. The following chemical used in 'Lead' pencils is:
- PbS
 - PbO
 - Pb
 - Graphite
- Q10. Formula of dry ice is:
- CO_2
 - CO
 - C
 - H_2O
- Q11. The percentage of carbon is least in:
- White cast iron
 - Grey cast iron
 - Wrought iron
 - Steel
- Q12. Carbon reacts with metals to form:
- Carbides
 - Carbonates
 - Oxides
 - Hydroxides
- Q13. The glass which contains PbO is:
- Pyrex glass
 - Hard glass
 - Flint glass
 - Soft glass
- Q14. The structure of SiO_2 is:
- Octahedral
 - Tetrahedral
 - Trigonal
 - Linear
- Q15. The inert form of carbon is:
- Diamond
 - Graphite
 - Coal
 - Charcoal
- Q16. The general electronic configuration of the atoms of the elements of carbon family is:
- ns^2np^5
 - ns^2
 - ns^2np^2
 - ns^2np^4
- Q17. Carbon is a:
- Metal
 - Metalloid
 - Non-metal
 - Alloy
- Q18. As one goes down the elements of carbon family, it is predicted that there will be an increase in:
- metallic character
 - non-metallic character
 - melting point
 - ionization potential
- Q19. As we go down the group IVA, we find that the atomic radius:
- decreases
 - increases
 - remain unchanged
 - first increases & then decreases

Group IVA Elements (Carbon Family)

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- Q20. Among the oxides of carbon & silicon, CO_2 is a gas because:
- of the presence of discrete CO_2 molecules held together by weak Vander Waal's forces
 - CO_2 forms an infinite three dimensional network
 - of the presence of induced dipole-dipole attraction
 - of the presence of H-bonding
- Q21. Nature of chemical bonding in diamond is:
- Ionic
 - Covalent
 - Metallic
 - Co-ordinate Covalent
- Q22. Red lead (Sandhur) is:
- PbO_2
 - Pb_3O_4
 - PbO
 - $[\text{2PbO.PbO}_2]$
- Q23. Density of diamond is about:
- 2.25 g/cm^3
 - 4.01 g/cm^3
 - 3.51 g/cm^3
 - None of these
- Q24. In graphite, each carbon atom is _____ hybridized:
- SP^3
 - SP^2
 - SP
 - SP^3d^2
- Q25. In graphite, the hexagonal rings form different layers which are held together by:
- Ionic bonds
 - Covalent bonds
 - Weak Vander waal's forces
 - Hydrogen bonds
- Q26. Which of the following facts regarding the structure of diamond can explain the high melting point & great hardness of diamond:
- C-C bond is covalent
 - C-atoms are arranged in tetrahedral lattice
 - C-C bond length is 1.54 \AA
 - Each C-atom is sp^3 hybridized
- Q27. Two & more forms of the same element which differ in the arrangement of atoms in the crystal lattice are called:
- Isotopes
 - Allotropes
 - Isomorphous
 - Homologues
- Q28. Phosgene is:
- PH_3
 - POCl_3
 - CS_2
 - COCl_2
- Q29. $[\text{2PbCO}_3.\text{Pb(OH)}_2]$ is the composition of:
- White lead pigment
 - Chrome yellow pigment
 - Red lead pigment
 - Chrome red pigment.
- Q30. Which is also called as triplumbic tetraoxide or lead-sesquioxide or Sandhur:
- white lead pigment
 - red lead pigment
 - turner's yellow pigment
 - chrome red pigment
- Q31. When Potassium Chromate solution is added to lead nitrate solution, precipitates obtained are of:
- Pb_2CrO_4
 - PbCrO_4
 - PbO
 - none of the above
- Q32. Yellow lead monoxide is also known as:
- Litharge
 - Epsom
 - Massicot
 - none of these
- Q33. The amorphous allotropic form of carbon are:
- Coke only
 - Coke & Charcoal only
 - Coal, Coke, Charcoal & lamp black
 - none of these
- Q34. Which of the following elements does not show allotropy:
- C
 - S
 - Sn
 - Pb
- Q35. The Crystalline allotrope of carbon is:
- Diamond
 - Charcoal
 - Lamp black
 - Coke
- Q36. Oxide of an element is a gas & it dissolves in water to give an acid. The element in the Periodic table exists in the group:
- I
 - II
 - III
 - IV

Topic 17

Group VA Elements
(Nitrogen Family)

Group VA of the periodic table consists of five elements, Nitrogen, Phosphorous, Arsenic, Antimony and Bismuth.

Nitrogen occurs in the free state in nature while all the remaining elements occur in the combined state.

All the elements except bismuth show allotropy.

Nitrogen is gas, Phosphorous is a soft, waxy and lustreless solid, As is a hard lustreless solid and Sb & Bi are hard solids and have characteristics metallic lustre.

N and P are exclusively non-metals, As and Sb are metalloids and Bi is definitely a metal.

Values of first ionization energies decrease on descending the group.

There is a pronounced increase in hardness and density in going from P to Bi.

N and P are non-conductors, As is a poor conductor, Sb is good conductor and Bi is an excellent conductor.

All the elements of this group form hydrides like MH_3 ($M=N, P, As, Sb, Bi$) and M_2H_4 ($M=N, P$).

All the elements of this group form oxides. Most important oxides are trioxides (M_2O_5). Besides these, nitrogen also gives nitrous oxide (N_2O) and nitric oxide (NO). Both these oxides are neutral, Bismuth also forms bismuth monoxide (BiO).

EXERCISE

- Q01. Which one of the group VA elements is the most abundant in the earth's crust?
A. Nitrogen B. Phosphorous
C. Arsenic D. Antimony
- Q02. Which one of the following is the most stable?
A. NH_3 B. PH_3
C. AsH_3 D. SbH_3
- Q03. Which one of the following statements is not correct for nitrogen?
A. It is a typical non-metal
B. Its molecular size is small
C. Its Electronegativity is very high
D. d-orbitals are available for bonding

- Q04. In the exothermic reaction,
 $N_2 + 3H_2 \rightleftharpoons 2NH_3$. The formation of ammonia is favoured by:
A. High temperature B. Low pressure
C. Low temperature D. The use of copper catalyst
- Q05. Which one of the following nitrogenous fertilizers has the highest nitrogen content?
A. Ammonium nitrate
B. Ammonium sulphate
C. Calcium ammonium nitrate
D. Urea
- Q06. Aqua regia is a mixture of:
A. $3HCl + 1HNO_3$ B. $H_3PO_4 + H_2SO_4$
C. $3HNO_3 + 1HCl$ D. $HCl + CH_3COOH$
- Q07. Yellow colour of commercial nitric acid is due to the presence of:
A. NO B. NO_2
C. N_2O D. N_2O_5
- Q08. According to Hund's rule, the correct electronic configuration of Nitrogen is:
A. $1s^2, 2s^2, 2p^3$
B. $1s^2, 2s^2, 2p_x^2, 2p_y^1$
C. $1s^2, 2s^2, 2p_x^1, 2p_y^1, 2p_z^1$
D. None of the above
- Q09. Group VA of the Periodic table has the general electronic configuration:
A. $ns^2 np^3$ B. $ns^2 np^6$
C. $ns^2 np^5$ D. $ns^2 np^4$
- Q10. Nitric acid is manufactured by:
A. Lead chamber method
B. Ostwald's method
C. Haber's process D. Contact process
- Q11. The first Ionization Potential of P, when compared with first ionization potential of S is:
A. greater B. lesser
C. equal D. none of these
- Q12. An element 'A' may belong to any of the first three groups of P-block elements. Its oxide dissolves in water & produce a strong acid. The element belongs to the following group:
A. III B. IV
C. V D. VI
- Q13. Nitric acid is prepared commercially by the oxidation of:
A. NO_2 B. Ammonia
C. Chlorine D. N_2O
- Q14. In Ostwald's methods, ammonia is oxidized to NO in the presence of catalyst:
A. finely divided iron B. V_2O_5
C. Platinum D. Copper
- Q15. Nitrogen Peroxide (NO_2) is dissolved in water to obtain:
A. HCl B. H_2SO_4
C. HNO_3 D. HNO_2

Group VA Elements (Nitrogen Family)

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- Q16. Ordinary nitric acid contains:
 A. 65% HNO_3 B. 79% HNO_3
 C. 98% HNO_3 D. 100% HNO_3
- Q17. Fuming nitric acid contains:
 A. Some H_2SO_4
 B. dissolved oxides of nitrogen
 C. both of them D. none of these
- Q18. Which of the following statement is not correct:
 A. Nitric acid is strong oxidizing agent
 B. Oxidizing property of HNO_3 is due to presence of N in its highest oxidation state of +5
 C. Nitric acid is a strong reducing agent
 D. Nitric acid neutralizes bases
- Q19. The degree of oxidation in nitric acid depends upon:
 A. the concentration of acid
 B. nature of element
 C. both of them
 D. none of these
- Q20. By reaction with copper, dilute HNO_3 is reduced to:
 A. NO B. NO_2
 C. N_2O D. N_2O_5
- Q21. Mark the element which gives M^{-3} ion:
 A. Sulphur B. Nitrogen
 C. Oxygen D. Fluorine
- Q22. The molecular formula of phosphorus is:
 A. P_1 B. P_2
 C. P_3 D. P_4
- Q23. Mark the laughing gas:
 A. Nitric oxide B. Nitrous oxide
 C. Nitrogen trioxide
 D. Nitrogen Pentaoxide
- Q24. The chemical used for cooling in electrical refrigeration is:
 A. Liquid NH_3 B. NH_4Cl
 C. NH_4OH D. CO_2
- Q25. How is ammonia generally manufactured for fertilizers?
 A. $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$
 B. By passing an electronic discharge in the mixture of N_2 & H_2
 C. By passing a mixture of N_2 & H_2 under high pressure & moderate temperature over a catalyst
 D. By reducing the by product HNO_3

Chemistry

Topic-18

Group VIA Elements (Oxygen Family)

1. Group VIA of the periodic table consists of five elements, Oxygen, Sulphur, Selenium, Tellurium and Polonium.
2. The elements O, S, Se and Te are often collectively called as Chalogens i.e., the ore forming elements.
3. With the rise of atomic number, the density, the atomic volume, the melting point and the boiling point all show a steady increase, Polonium shows exception.
4. Due to decrease of ionization energy from oxygen to Polonium, the metallic character of these elements increases down the group. Oxygen and Sulphur are distinctly non-metallic and some of the metallic properties begin to develop in Selenium and Tellurium. Polonium which is radioactive is definitely a metal.
5. Oxygen molecule is diatomic (O_2) while the molecules of other elements are more complex, e.g. Sulphur, Selenium, and Polonium are octatomic molecules i.e. S_8 , Se_8 , and Po_8 with puckered ring structures.
6. All the elements show allotropy, e.g.; oxygen exists in two non-metallic forms i.e. O_2 and O_3 . Sulphur has several allotropic forms all of which are non-metallic (rhombic, monoclinic and plastic sulphur). Se has two forms; red (non-metallic) and grey (metallic).
7. Oxygen and to a greater extent, sulphur shows the property of catenation.
8. All the elements of this group form hydrides of H_2M type where $M = O, S, Se, Te$ and Po .
9. Sulphur forms a large number of oxy-acids.

EXERCISE

- Q01. Which one of the following show paramagnetism?
- | | |
|------------|-------------|
| A. Oxygen | B. Nitrogen |
| C. Sulphur | D. Selenium |

- Q02. Ozone is an:
- A. Isomer of oxygen
 - B. Isotope of oxygen.
 - C. Allotrope of oxygen
 - D. Isobar of oxygen
- Q03. Which one of the following hydrides of group VIA element has the highest boiling point?
- | | |
|------------|------------|
| A. H_2S | B. H_2O |
| C. H_2Se | D. H_2Te |
- Q04. The boiling point of H_2O is highest in all the elements of group VIA because of:
- A. neutral character of the molecule
 - B. hydrogen bonding in the molecule
 - C. polarity of the molecule
 - D. all are correct
- Q05. Structure of SF_6 involves hybridization of the type:
- | | |
|--------------|------------|
| A. sp^3 | B. dsP^3 |
| C. sp^3d^2 | D. sp^2 |
- Q06. $2H_2S + SO_2 \longrightarrow 3S + 2H_2O$. The reaction depicts which of the property of SO_2 :
- A. an oxidizing property
 - B. a reducing property
 - C. its basic property
 - D. its acidic property
- Q07. The general electronic configuration of VIth group is:
- | | |
|----------------|----------------|
| A. $ns^2 np^2$ | B. $ns^2 np^6$ |
| C. $ns^2 np^4$ | D. $ns^2 np^5$ |
- Q08. H_2SO_4 has great affinity for water because:
- A. it decomposes the acid
 - B. it hydrolysed the acid
 - C. acid decomposes water
 - D. it acts as dehydrating agent
- Q09. Which one of the following is Rhombic sulphur:
- | | |
|----------|----------|
| A. S_2 | B. S_4 |
| C. S_6 | D. S_8 |
- Q10. Which one of the following dissolves in H_2SO_4 to form oleum?
- | | |
|-----------|-----------|
| A. SO_2 | B. SO_3 |
| C. NO_2 | D. H_2S |
- Q11. Which of the following is the most electronegative:
- | | |
|------|-------|
| A. S | B. P |
| C. B | D. Na |
- Q12. Which of the following has lowest ionization potential value?
- | | |
|------|-------|
| A. N | B. O |
| C. F | D. Ne |
- Q13. Important Crystalline form of sulphur is:
- A. Only rhombic sulphur
 - B. Only monoclinic sulphur
 - C. Both rhombic & monoclinic sulphur
 - D. Plastic sulphur

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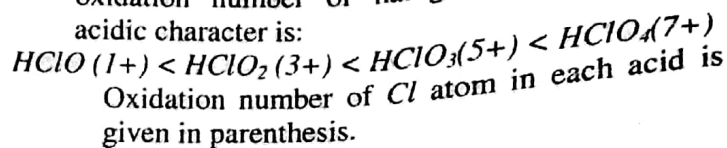
- Q14. Which allotropic form of Sulphur consists of sulphur atoms in S_8 molecules giving ring:
 A. Rhombic sulphur
 B. Monoclinic sulphur
 C. Both of them
 D. None of these
- Q15. The transition temperature at which rhombic & monoclinic sulphur are in equilibrium is:
 A. 112.8°C
 B. 119.25°C
 C. 115°C
 D. 95.5°C
- Q16. Which form of sulphur is composed of long chains of sulphur atoms coiled up?
 A. Plastic sulphur
 B. Monoclinic sulphur
 C. Rhombic sulphur
 D. All of the above
- Q17. Plastic sulphur is also known as:
 A. α -sulphur
 B. β -sulphur
 C. γ -sulphur
 D. None of these
- Q18. Prismatic sulphur is also known as:
 A. β -sulphur
 B. plastic sulphur
 C. α -sulphur
 D. Octahedral sulphur
- Q19. H_2S can be prepared in laboratory by treating FeS with:
 A. H_2SO_4 only
 B. HCl only
 C. H_2SO_4 or HCl
 D. HNO_3 only
- Q20. Solution of H_2S in water is:
 A. acidic
 B. basic
 C. neutral
 D. Strongly basic
- Q21. H_2SO_4 reacts with benzene to form:
 A. Benzoic acid
 B. Benzene sulphononic acid
 C. Hexa sulphononic acid
 D. None of these
- Q22. H_2SO_4 is used in the manufacture of:
 A. Super phosphates
 B. Ammonium nitrate
 C. Rayon
 D. All of them
- Q23. The catalyst used in the manufacture of H_2SO_4 by contact process is:
 A. Finely divided iron
 B. Ni
 C. V_2O_5
 D. Oxides of N_2
- Q24. Which form of sulphur is insoluble in water as well as in CS_2 :
 A. Rhombic sulphur
 B. Prismatic sulphur
 C. Plastic sulphur
 D. None of the above
- Q25. Sulphuric acid is a dibasic acid because:
 A. each molecule contains two hydrogen ion
 B. each molecule ionizes to form two protons
 C. it turns blue litmus red
 D. Sulphur has a valency of two
- Q26. The charring action of sulphuric acid due to its being:
 A. A strong acid
 B. An oxidizing agent
 C. A dehydrating agent
 D. A reducing agent
- Q27. The gas produce in Kipps apparatus by the action of HCl or H_2SO_4 on ferrous sulphide (FeS) is:
 A. SO_2
 B. H_2S
 C. Cl_2
 D. HCl
- Q28. The SO_3 produced in contact tower is absorbed first by the H_2SO_4 conc. to form oleum, its chemical formula is:
 A. H_2SO_4
 B. $H_2S_2O_7$
 C. SO_2
 D. CH_3NO_2
- Q29. Which is often known as oil of vitriol:
 A. HCl
 B. HNO_3
 C. H_2SO_4
 D. Fatty acid
- Q30. Which of the following statements is not correct?
 A. H_2SO_4 acts as oxidizing agent
 B. H_2SO_4 has high boiling point
 C. Viscosity of H_2SO_4 is high
 D. H_2SO_4 acts as reducing agent
- Q31. $C + 2H_2SO_4 \longrightarrow CO_2 + 2SO_2 + 2H_2O$. The reaction shows which property of H_2SO_4 :
 A. As weak acid
 B. As strong acid
 C. As an oxidizing agent
 D. As reducing agent
- Q32. When sulphur is heated with H_2 upto 600°C - 650°C it forms:
 A. SO_2
 B. SO_3
 C. H_2S
 D. H_2SO_4
- Q33. By burning sulphur or iron pyrites, ----- is produced:
 A. SO_3
 B. SO_2
 C. FeO
 D. H_2SO_4
- Q34. The favourable conditions for obtaining maximum yield of SO_3 are (Tick on wrong statement):
 A. High temperature
 B. Low temperature
 C. High pressure
 D. Presence of catalyst.
- Q35. Oleum is also known as:
 A. hypochlorous acid
 B. Pyrosulphuric acid
 C. fuming sulphur acid
 D. fuming nitric acid

Topic 19

Group VIIA Elements
(Halogens Family)

- Group VII A of the periodic table consists of five elements, Fluorine, Chlorine, Bromine, Iodine & Astatine.
- The elements F , Cl , Br , I are collectively called Halogens.
- Astatine is an unstable element of radioactive origin.
- All the halogens exist as covalent, diatomic molecules in the gaseous, liquid and crystalline states. These discrete X_2 molecules are held together by weak Vander Waal's forces which explain the volatile nature of these elements.
- These elements have high electron affinity values.
- These have large values of electronegativity. These values decrease as we proceed from F to I in the group.
- There is a change of state from gas to solid and hence density increases from F to I .
- All the halogens are coloured. Fluorine appears yellow, iodine appears deep violet, chlorine appears greenish yellow and bromine appears reddish brown.
- All the halogens have very pungent and unpleasant odours.
- The halogens are slightly soluble in water and their solubility decreases from Cl to I . The halogens dissolve much better than H_2O in many organic solvents like carbon disulphide, chloroform, ether etc.
- All the halogen acids in the gaseous state are essentially covalent but in the aqueous solution, they ionize to give the solvated proton and hence act as acids.
- Anhydrous HF is a liquid at ordinary temperature whereas other HX ($X = Cl, Br, I$) are colourless gases.
- Excepting HF , the melting and boiling points of these hydrides increase with the increase of atomic weight of the halogen atom.
- As we go from HF to HI , the stability of these acids decreases from HF to HI .
- Excepting F , all other halogens form oxy-acids.
- In the series of oxy-acids of the same halogen in different oxidation number, the acidic character

of such acids increases with the increase of the oxidation number of halogen. Thus order of acidic character is:



EXERCISE

- Q01. Which of the following halogens is liquid at room temperature?
A. Fluorine B. Chlorine
C. Bromine D. Iodine
- Q02. Which of the following halogens is solid at room temperature?
A. Fluorine B. Bromine
C. Chlorine D. Iodine
- Q03. Which of the following halogens exhibits only one oxidation state?
A. Fluorine B. Iodine
C. Chlorine D. Bromine
- Q04. Which of the following halogens shows the greatest affinity for hydrogen?
A. Fluorine B. Chlorine
C. Bromine D. Iodine
- Q05. Which of the following halogens has the highest electron affinity?
A. Fluorine B. Chlorine
C. Bromine D. Iodine
- Q06. Which of the following halogens oxidizes water to oxygen with evolution of large amount of heat?
A. Fluorine B. Bromine
C. Chlorine D. Iodine
- Q07. The sum of energy terms involved in the reaction, $\frac{1}{2} X_{2(g)} \rightarrow X^-(aq)$ (where X is a halogen) is the highest in the case of:
A. Fluorine B. Chlorine
C. Bromine D. Iodine
- Q08. Standard electrode potential is the highest for:
A. $\frac{1}{2} I_2 + e^- \longrightarrow I^-$ B. $\frac{1}{2} Br_2 + e^- \longrightarrow Br^-$
C. $\frac{1}{2} F_2 + e^- \longrightarrow F^-$
D. $\frac{1}{2} Cl_2 + e^- \longrightarrow Cl^-$
- Q09. Which one of the following pairs is not correctly matched?
A. A halogen which is liquid at room temperature ---- Bromine
B. The most electronegative element ---- Fluorine
C. The most reactive halogen ---- Fluorine
D. The strongest oxidizing halogen ---- Iodine

- Q10. The correct increasing order of the electron affinity values of F , Cl , Br & I atoms is:
 A. $I < Br < F < Cl$ B. $I < F < Br < Cl$
 C. $I < Cl < F < Br$ D. $I < Cl < Br < F$
- Q11. P-block elements occurs in:
 A. Groups IA & IIA
 B. Groups IIIA to zero group
 C. Group IB to VIIB D. None of the above
- Q12. In the preparation of chlorine from HCl , MnO_2 acts as:
 A. Oxidizing agent B. Reducing agent
 C. Catalytic agent D. Dehydrating agent
- Q13. Chlorine acts as a bleaching agent only in the presence of:
 A. Dry air B. Moisture
 C. Sunlight D. Pure oxygen
- Q14. Which of the hydrogen halides is the most stable:
 A. HF B. HCl
 C. HBr D. HI
- Q15. Which of the hydrogen halides is the least polar?
 A. HF B. HCl
 C. HBr D. HI
- Q16. Which of the hydrogen halides is the most reducing in character?
 A. HF B. HCl
 C. HBr D. HI
- Q17. Which of the hydrogen halides has the lowest boiling point?
 A. HF B. HCl
 C. HBr D. HI
- Q18. Hypochlorous acid is:
 A. $HOCl$ B. $HClO_2$
 C. $HClO_3$ D. $HClO_4$
- Q19. Which one of the following is the strongest acid?
 A. HNO_3 B. H_2SO_4
 C. $HClO_4$ D. HCl
- Q20. The size of the iodine species follows the order:
 A. $I^+ < I < I^-$ B. $I^+ < I^- < I$
 C. $I^- < I^+ < I$ D. $I < I^- < I^+$
- Q21. Chlorine reacts with water to form HCl & $HOCl$. This reaction is:
 A. Oxidation B. Reduction
 C. Displacement D. Self oxidation-reduction
- Q22. Chlorine has bleaching action in the presence of moisture. The bleaching action of chlorine is due to the formation of:
 A. HCl B. $HOCl$
 C. Cl_2 D. SO_2
- Q23. Chlorine is manufactured by:
 A. Nelson cell
 B. Castner Kellner process
 C. Deacon's process D. All of the above
- Q24. Cl^- ion is converted into Cl_2 by using:
 A. Conc. $HClB$. HBr
 C. H_2S D. F_2

Zero Group Elements (Inert Gases)

1. Zero group of the periodic table consists of six elements namely Helium, Neon, Argon, Krypton, Xenon and Radon. These elements are also called by other names like inactive gases, inert gases, rare gases and noble gases.
2. Excepting radon, all other noble gases occur throughout the universe in atomic state.
3. Since radon is a radioactive element and hence decays rapidly, it does not occur in the free state.
4. The electronegativity and electron affinity of these elements are zero.
5. The ionization potential of these gases are very high. Hence, the removal of electron from the outer most shell is very difficult.
6. Of all the noble gases, only He and Ar which are available easily have many uses. The uses are due to their chemical inertness and low boiling points.
7. Helium is used in gas cooled atomic reactors as a heat transfer gas i.e. as a cooling medium. This use of helium is because of the following properties of this gas:
 - i) It has high thermal conductivity.
 - ii) It has low viscosity.
 - iii) It is inert and does not undergo corrosion.
 - iv) Mixed with O_2 , it is used in the treatment of asthma. Being light, this gas diffuses more rapidly than air through the partly choked lung passages. The mixture of He and O_2 is used for artificial breathing of asthma patients.
8. Helium nucleus (α -particles) is used as a bombarding particle for the artificial disintegration of atoms.
9. Neon is used in neon discharge lamps and signs for advertising purposes.
10. Argon is used for producing inert atmosphere in welding and metallurgy of certain metals, which are easily oxidized.
11. Radon is used in the preparation of ointment for the treatment of cancer and other diseases.

12. The inert gases Ar, Kr and Xe form compounds with water at low temperature and high pressure, known as hydrates. E.g; Ar. $6H_2O$, Kr. $6H_2O$ and Xe. $6H_2O$.
13. In clathrates, the noble gases trapped into the cavities of crystal lattices of certain organic and inorganic compounds.
14. In these, no chemical bonding is involved. The clathrates are normally non-stoichiometric compounds.
15. Some compounds of noble gases are XeF_2 , XeF_4 , XeF_6 , XeO_3 , $XeOF_4$, KrF_2 etc.

EXERCISE

- Q01. Which of the following is the most abundant in atmosphere?

A. Kr	B. Ar
C. Ne	D. Xe
- Q02. A rare gas that was detected in the sun before it was discovered on earth is:

A. He	B. Ne
C. Kr	D. Xe
- Q03. Which of the following noble gases is obtained by radioactive disintegration?

A. Kr	B. Ar
C. Rn	D. Xe
- Q04. Helium is used in gas balloons in place of hydrogen, since it is:

A. incombustible
B. radioactive & hence can be deflected easily
C. lighter than hydrogen
D. more abundant than hydrogen
- Q05. The gas used in colour discharge tubes is:

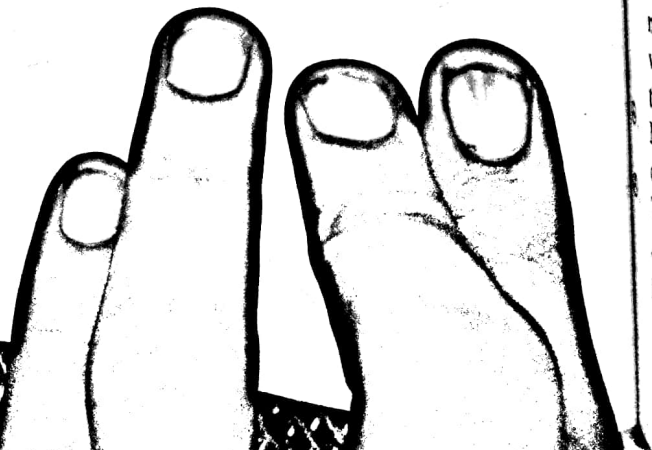
A. Ar	B. Ne
C. Kr	D. Xe
- Q06. Helium is added to oxygen supply used by sea divers, because:

A. it is less soluble in blood than nitrogen at high pressures.
B. it is lighter than nitrogen.
C. it is readily miscible with O_2
D. it is less poisonous than N_2
- Q07. The gas which is used for inflating the tyres in aeroplanes is:

A. H_2	B. He
C. N_2	D. Ar
- Q08. Which one of the following configurations represents a noble gas (excepting helium)?

A. $1s^2, 2s^2, 2p^6, 3s^2$
B. $1s^2, 2s^2, 2p^6$
C. $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
D. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$

- Q09. The red light emitted by a neon sign comes from:
 A. A metal wire inside the glass tubing which is heated until red hot by a current passing through it.
 B. The oxidation of neon with in the glass tubing
 C. A luminous gas at low pressure inside the glass tubing
 D. A luminous red liquid inside the glass tubing.
- Q10. Noble gases are generally unreactive, because:
 A. they have high ionization energy
 B. they form diatomic molecules easily
 C. they have high electron affinity
 D. they are highly electropositive.
- Q11. The melting and boiling point of the noble gases increases on descending the group because:
 A. atomic number increase
 B. atomic weight increases
 C. size of atom increases
 D. the magnitude of Vander Waal's forces increases
- Q12. The rare gases are:
 A. diatomic B. Polyatomic
 C. monoatomic D. none of the above
- Q13. Which of the following statements is correct?
 A. Helium is lighter than air
 B. Neon is iso-electronic with helium
 C. Argon is the rarest of the noble gases
 D. Helium is heavier than air
- Q14. Element with highest ionization potential is:
 A. Hydrogen B. Sodium
 C. Helium D. Lead
- Q15. Among the zero group elements the element that forms many chemical compounds is:
 A. Helium B. Neon
 C. Argon D. Xenon
- Q16. Which of the following is not a noble gas?
 A. Ar B. Kr
 C. Xe D. Ra
- Q17. Which of the following is the electronic configuration of a noble gas?
 A. $[He] 2S^2$ B. $[Ne] 3S^2 3P^2$
 C. $[Ar] 3d^{10} 4S^2 4P^4$ D. $[Kr] 4d^{10} 5S^2 5P^6$
- Q18. Which one of the noble gases was observed in the solar spectrum?
 A. He B. Ne
 C. Ar D. Rn
- Q19. Which one of the following noble gases has the highest boiling point?
 A. He B. Ne
 C. Xe D. Kr
- Q20. The last orbit of Argon would have electrons?
 A. 8 B. 18
 C. 2 D. 32
- Q21. Least chemical activity is shown by:
 A. Ammonia B. Methane
 C. Argon D. Sulphuric acid
- Q22. Noble gases do not react with other elements because:
 A. are mono-atomic
 B. are not found in abundance
 C. the sizes of their atoms are very small
 D. they have completely paired up & stable electron shells
- Q23. Which of the following fluorides of xenon is impossible:
 A. XeF_2 B. XeF_3
 C. XeF_4 D. XeF_6
- Q24. The following has zero valency:
 A. Sodium B. Beryllium
 C. Krypton D. Aluminum
- Q25. The forces acting between noble gas atoms are:
 A. Vander Waal's forces
 B. Ion-dipole forces
 C. London-dispersion forces
 D. Dipole-dipole forces
- Q26. Which of the following is least inert?
 A. Helium B. Neon
 C. Argon D. Xenon



Topic 21

d-Block Elements (Transition Metals)

- ① In these elements, either in their atomic state or in any of their common oxidation state, the last electron enters the d-orbital of the penultimate shell.
- ② With the exceptions of *Cr, Cu, Nb, Mo, Ru, Rh, Pd, Ag, Pt* and *Au*, in the atoms of these elements, the ns orbital is completely filled. Consequently, the valence shell configuration varies from $(n-1)d^1 ns^2$ (group III B) to $(n-1)d^{10} ns^2$ (group II B).
- ③ Elements of groups III B, IV B, VB, VI B, VII B, VIII, I B and II B belong to this block.
- ④ The d-block elements are called transition elements as they exhibit transitional behaviour between highly reactive s-block and mainly covalent compound forming p-block elements.
- ⑤ d-block elements have high melting and boiling points. However, *Zn, Cd* and *Hg* have relatively low values.
- ⑥ Most of the transition metals show several oxidation states or variable in their compounds.
- ⑦ Compounds of transition metals in the solid or in solution state are usually coloured.
- ⑧ The hydrated cations (e.g. Sc^{3+} , Ti^{4+} , Cu^+ , Zn^{2+}) having vacant or completely filled d-orbitals are colourless while those (e.g. Ti^{3+} , V^{3+} , Cr^{3+} , etc) having partially filled d-orbitals are coloured.
- ⑨ The cations of d-block elements have a strong tendency to form complexes. The molecules or ions with which the cations attach themselves to form complexes are called ligands.
- ⑩ Many of the compounds given by transition metals are non-stoichiometric compounds (due to variable valency and due to the defects existing in the solid structures).
- ⑪ Most of the transition metals and their compounds are used as catalysts.
- ⑫ Transition metals form alloys with each other. Alloys are usually harder and have higher melting point than the parent metals.

EXERCISE

- Q01. Transition metals:
 - A. do not show catalytic activity
 - B. exhibit inert pair effect
 - C. have low melting points
 - D. show variable oxidation state
- Q02. Transition metals belong to the:
 - A. s-block
 - B. p-block
 - C. d-block
 - D. f-block
- Q03. Which one of the following transition metal ions is coloured?
 - A. Cu^+
 - B. V^{2+}
 - C. Sc^{3+}
 - D. Ti^{4+}
- Q04. Which one of the following metal ions is diamagnetic?
 - A. Cr^{3+}
 - B. V^{3+}
 - C. Ti^{3+}
 - D. Sc^{3+}
- Q05. The highest magnetic moment is shown by the transition metal ion with the outer electronic configuration:
 - A. $3d^2$
 - B. $3d^5$
 - C. $3d^7$
 - D. $3d^9$
- Q06. Which one of the following metal ions has the highest number of unpaired electrons?
 - A. Mn^{2+}
 - B. Fe^{2+}
 - C. Co^{2+}
 - D. Ni^{2+}
- Q07. Which one of the following is not a transition metal?
 - A. Gold
 - B. Silver
 - C. Thallium
 - D. Scandium
- Q08. Which one of the following metal exists in liquid form?
 - A. *Hg*
 - B. *Sc*
 - C. *Ag*
 - D. *Mn*
- Q09. Which is the correct IUPAC name for $K_3[Fe(CN)_6]$ is?
 - A. Potassium ferricyanide
 - B. Potassium ferrocyanide
 - C. Potassium hexacyanoferrate (II)
 - D. Potassium hexacyanoferrate (III)
- Q10. Which one of the following transition metal has the lowest melting point?
 - A. Scandium
 - B. Titanium
 - C. Zinc
 - D. Vanadium
- Q11. Which is the most stable oxidation state of $Cr(d^5 s^1)$?
 - A. +2
 - B. +6
 - C. +5
 - D. +4
- Q12. What is the colour of the complex $[Cu(NH_3)_4]^{2+}$?
 - A. blue
 - B. green
 - C. orange
 - D. red

- Q13. Iron obtained from blast furnace is known as?
 A. Cast iron B. Wrought iron
 C. Pig iron D. Steel
- Q14. Mohr's salt is:
 A. $(\text{NH}_4)_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$
 B. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
 C. $\text{Al}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 \cdot 24\text{H}_2\text{O}$
 D. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- Q15. Blue vitriol is:
 A. CoCl_2 B. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 C. $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ D. ZnSO_4
- Q16. d-block elements generally form:
 A. Covalent hydrides
 B. Complex hydrides
 C. Interstitial hydrides
 D. Salt-like hydrides
- Q17. The chief ore of copper is:
 A. Cuprite B. Malachite
 C. Azurite D. Copper pyrite
- Q18. The Matte is an impure substance of:
 A. Iron B. aluminium
 C. Copper D. Zinc
- Q19. Which of the following has lowest % of carbon?
 A. Cast iron B. wrought iron
 C. Steel
 D. all have same percentage
- Q20. Iron gets rusted by the action of:
 A. air B. air & water
 C. air, Water & CO_2 D. air & CO_2
- Q21. Purest form of iron is:
 A. white cast iron B. grey cast iron
 C. Steel D. wrought iron
- Q22. Coinage metals show the properties of:
 A. typical elements B. normal elements
 C. transition elements D. inert element
- Q23. One of the constituents of German silver is:
 A. Ag B. Cu
 C. Mg D. Al

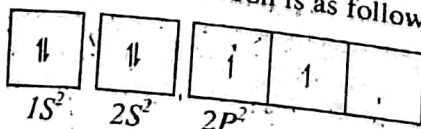
- Q24. Which element is alloyed with copper to form brass?
 A. Pb B. Bi
 C. Zn D. Al
- Q25. Blister copper is:
 A. pure copper B. ore of copper
 C. alloy of copper D. impure copper
- Q26. Galvanization is the:
 A. deposition of Zn on Fe
 B. deposition of Al on Fe
 C. deposition of tin on Fe
 D. deposition of Cu on Fe
- Q27. Sodium thiosulphate is used in photography because of its:
 A. reducing behaviour
 B. oxidizing behaviours
 C. complex forming behaviours
 D. reaction with light
- Q28. Photographic films and plates have as an essential ingredient:
 A. Silver nitrate B. Silver bromide
 C. Sodium bromide D. none of these
- Q29. The correct formula of hypo is:
 A. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ B. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$
 C. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ D. Na_2SO_4
- Q30. In photography, sodium thiosulphate is used for:
 A. marking the latent image visible
 B. intensifying faint images
 C. softening very dark images
 D. dissolving residual silver bromide
- Q31. During the extraction of aluminum by electrolysis, cryolite (Na_3AlF_6) is added because it:
 A. lowers the melting point
 B. add more aluminum to the cell
 C. is cheaper to use than bauxite
 D. none of the above

Chemistry

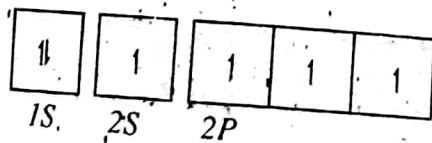
Topic 22

Introduction To Organic Chemistry

- Organic compounds are the compounds of carbon.
- Majority of the organic compounds possess covalent bonding.
- Many have low melting and boiling points. However, some are solids at room temperature and have high melting points. This can be seen in plastics because the molecules are extremely long, heavy polymers. In other cases, it is a result of some ionic bonding being present. e.g. amino acids such as glycine.
- Tetravalency of Carbon:** The ground state configuration of carbon is as follows:



The valency of an element is equal to the number of unpaired electrons. So, the valency of carbon must be two, but the simplest compound of carbon is CH₄ i.e. carbon is tetravalent. And in all other compounds, carbon shows tetravalency. So in excited state:



So, tetravalency of carbon atom is explained in excited state.

- Hybridization:** The phenomenon of mixing of pure atomic orbitals, having nearly the same energy to form hybrid orbital is called hybridization. The following three types of hybridization occur in case of carbon.

A) sp B) sp^2 C) sp^3

sp Hybridization:

- When one s-orbital and one p-orbital take part in hybridization.
- The bond angle between the two sp orbital is 180°.
- Each sp hybrid orbital possesses 50% s and 50% p character.
- Example; Acetylene (C₂H₂)

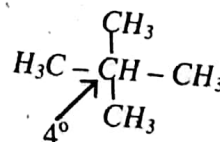
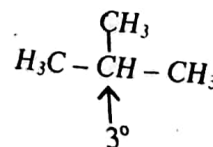
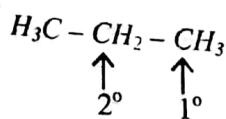
sp^2 Hybridization:

- When one s-orbital and two p-orbital take part in hybridization.

- The bond angle is 120°.
- Each sp^2 hybrid orbital possesses $\frac{1}{3}$ s-character and $\frac{2}{3}$ p-character.
- Example – ethane (C₂H₄)
- sp^3 Hybridization:**
 - When one s-orbital and three p-orbital take part in hybridization.
 - The bond angle is 109°28'.
 - Each hybrid orbital possesses 25% s and 75% p character.

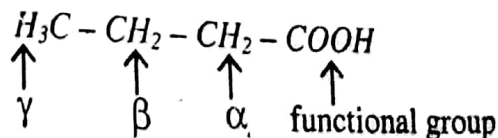
CLASSIFICATION OF CARBON ATOM

- Primary Carbon Atom:** When one carbon atom is attached to another carbon atom, it is called 1° carbon atom.
- Secondary Carbon Atom:** When carbon atom is attached to two other carbon atoms, it is called 2° carbon atom.
- Tertiary Carbon Atom:** When one carbon atom is attached to three other carbon atoms, it is called 3° carbon atom.
- Quaternary Carbon Atom:** When one carbon atom is attached with four other carbon atoms, it is called 4° carbon atom.



CLASSIFICATION OF HYDROGEN ATOM

The hydrogen atom present on carbon atom, which occupies first position from the functional group is called α-hydrogen atom; that occupying the second position from the functional group is called β-hydrogen atom and the one occupying the third position from the functional group is called γ-hydrogen atom.



CLASSIFICATION OF ORGANIC COMPOUNDS

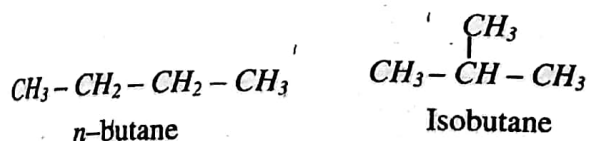
- Open Chain Compounds:** The hydrocarbons for example, methane, ethane, propane, ethene,

- Chemical formula** i.e. in the order in which different types of atoms are linked in the molecule.
- ②. Structural isomerism is of four types: chain isomerism, position isomerism, functional isomerism and metamerism.
- ③. In **stereoisomerism**, the isomers have the same molecular formula, same structural formula but differ in the spatial arrangement of the groups.
- ④. Stereoisomerism is of two types: geometrical isomerism and optical isomerism.

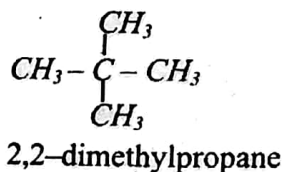
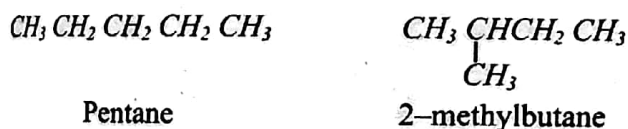
STRUCTURAL ISOMERISM

- ②. **Chain Isomerism:** Chain isomers have the same molecular formula but different arrangement of carbon atoms.

E.g. i) *n*-butane and isobutane (C_4H_{10})

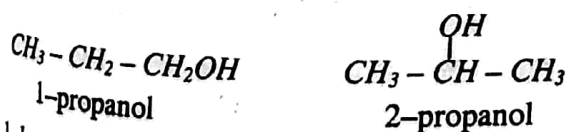


- ii) Pentane, 2-methylbutane and 2,2-dimethylpropane (C_5H_{12})

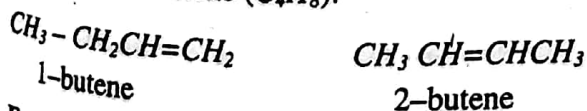


- ③. **Position Isomerism:** Position isomers have the same molecular formula but differ in the position of a substituent or functional group. There is no change in the carbon skeleton.

E.g. i) 1-propanol and 2-propanol (C_3H_8O):

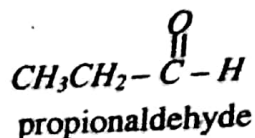
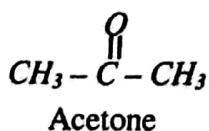
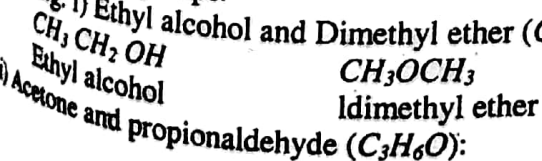


- ii) 1-butene and 2-butene (C_4H_8):

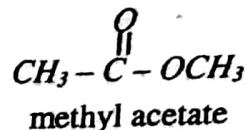
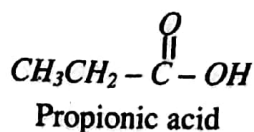


- ④. **Functional Isomerism:** Functional isomers have the same molecular formula but different functional groups.

E.g. i) Ethyl alcohol and Dimethyl ether (C_2H_6O):



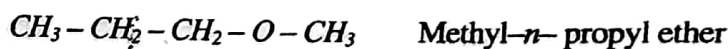
- iii) Propionic acid and methyl acetate ($C_3H_6O_2$):



- ⑤. **Metamerism:** This type of isomerism is exhibited by the compounds having same functional groups but different alkyl groups attached to the same multivalent atom.

i) Metamers belong to the same homologous series.

E.g. $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ Diethyl ether



- ⑥. **Geometrical Isomerism:** Geometrical isomerism results from a restriction of rotation about double bonds. The carbon atoms of the carbon - carbon double bond are sp^2 hybridized. The carbon - carbon double bond is made up of a σ bond and a π bond. The σ bond is formed by the overlap of sp^2 hybrid orbitals. The π bond is formed by the overlap of unhybridized p orbitals. The two carbon atoms of the $C = C$ bond and the four atoms that are attached to them all lie in one plane and their positions in space are fixed.

Rotation around the $C = C$ bond is not possible because rotation would break the π bond.

This restriction of rotation around the carbon - carbon double bond is responsible for geometrical isomerism in alkenes.

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All alkenes do not show geometrical isomerism. Geometrical isomerism is possible only when each carbon atom that forms the double bond is attached to two different groups.

PETROLEUM

Unrefined petroleum is obtained from ground or sea-deposits as 'crude oil'. It is a complex mixture of organic compounds. There are also small amounts of sulphur-containing compounds and compounds containing oxygen and nitrogen.

acetylene etc, having open chains of carbon atoms in their molecules are known as open chain or Acyclic compounds.

- ①. **Closed Chain Compounds:** The organic compounds in which carbon atoms are attached together to form a ring, are called closed chain compounds.

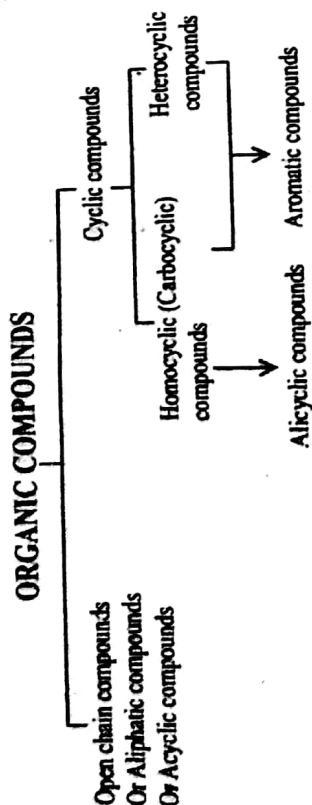
- ②. **Homocyclic or Carbocyclic Compounds:** The cyclic compounds which have rings made of only carbon atoms, are named as carbocyclic compounds.

- ③. **Heterocyclic Compounds:** The cyclic compounds which may also include one or more non-carbon (hetero; different) atoms such as O, N, S are called heterocyclic compounds. For example, benzene is carbocyclic and pyridine (C_5H_5N) is heterocyclic.

The carbocyclic and heterocyclic compounds could be further classified as monocyclic, bicyclic and tricyclic according as they contain one, two or three rings in their molecules. Thus, benzene and pyridine are monocyclic, naphthalene is bicyclic and anthracene is tricyclic.

- ④. **Alicyclic Compounds:** Such carbocyclic compounds in which the carbon atoms of the ring are joined by single covalent bonds and resemble with aliphatic compounds in properties, are called Alicyclic compounds e.g. cyclohexane.

- ⑤. **Aromatic Compounds:** The cyclic compounds which satisfy Huckel $(4n + 2) \pi$ electron rule, are known as aromatic compounds ($n = 1, 2, 3, \dots$)



Introduction To Organic Chemistry


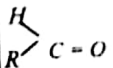
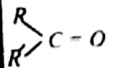
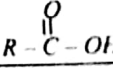
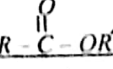
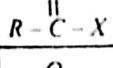
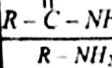
HOMOLOGOUS SERIES

The main characteristics of a homologous series are:

- ✧ Each successive member of the series differ by $-CH_2$ or a molecular weight of 14.
- ✧ Members of homologous series have the same functional group.
- ✧ Members of the series possess similar chemical properties.
- ✧ Have the same general formula.
- ✧ Gradually changing physical properties.

FUNCTIONAL GROUP

- ①. Functional group is defined as an atom or groups of atoms whose presence in an organic compound confers the properties to organic compound unique to that atom or group of atoms.
- ②. Each functional group has its own characteristic set of properties.

HOMOLOGOUS SERIES	GENERAL MOLECULAR FORMULA	FUNCTIONAL GROUP
1. Alkane	$C_n H_{2n+2}$ or $R-H$	-----
2. Alkene	$C_n H_{2n}$	$>C=C<$ double bond
3. Alkyne	$C_n H_{2n-2}$	$-C \equiv C-$ triple bond
4. Haloalkane	$C_n H_{2n+1} X$ or $R-X$ ($X = F, Cl, Br, I$)	$-X$ (halide group)
5. Alcohol	$C_n H_{2n+1} OH$ or $R-OH$	$-OH$ (hydroxyl group)
6. Phenol	 or C_6H_5OH	$-OH$ (hydroxyl group)
7. Ether	$R-O-R'$	$-OR'$ (alkoxy group)
8. Aldehyde		$H-C=O$ or $-CHO$ (carbonyl group)
9. Ketone		$>C=O$ (carbonyl group)
10. Carboxylic acid		$\begin{matrix} O \\ \\ -C-OH \end{matrix}$ (carboxyl group)
11. Ester		$\begin{matrix} O \\ \\ -C-OR' \end{matrix}$ (ester group)
12. Acid halide		$\begin{matrix} O \\ \\ -C-X \end{matrix}$ (acyl group)
13. Acid amide		$\begin{matrix} O \\ \\ -C-NH_2 \end{matrix}$ (amido group)
14. Primary amine	$R-NH_2$	$-NH_2$ (amino group)

ISOMERISM

- ①. Isomers are the compounds with same molecular formula but different physical and chemical properties. The phenomenon is called Isomerism.
- ②. The two main classes of isomerism are structural isomerism and stereoisomerism.
- ③. In **structural isomerism**, the isomers have the same molecular formula but differ in structural

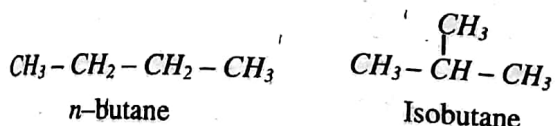
formula i.e. in the order in which different types of atoms are linked in the molecule.

- ⑧ Structural isomerism is of four types: chain isomerism, position isomerism, functional isomerism and metamerism.
- ⑨ In stereoisomerism, the isomers have the same molecular formula, same structural formula but differ in the spacial arrangement of the groups.
- ⑩ Stereoisomerism is of two types: geometrical isomerism and optical isomerism.

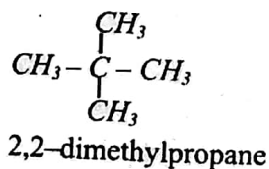
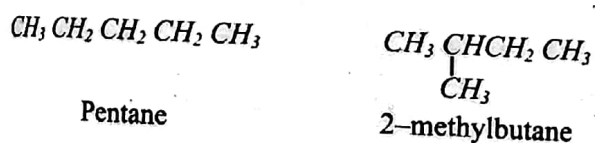
STRUCTURAL ISOMERISM

- ⑧ Chain Isomerism: Chain isomers have the same molecular formula but different arrangement of carbon atoms.

E.g. i) *n*-butane and isobutane (C_4H_{10})

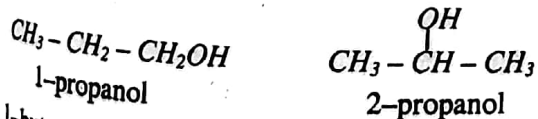


- ii) Pentane, 2-methylbutane and 2,2-dimethylpropane (C_5H_{12})

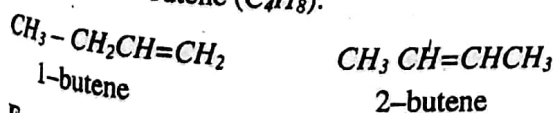


- ⑨ Position Isomerism: Position isomers have the same molecular formula but differ in the position of a substituent or functional group. There is no change in the carbon skeleton.

E.g. i) 1-propanol and 2-propanol (C_3H_8O):

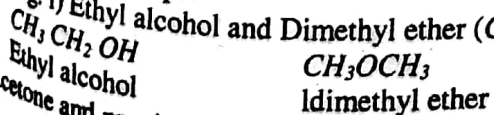


- ii) 1-butene and 2-butene (C_4H_8):

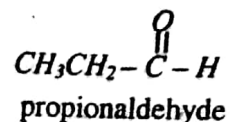
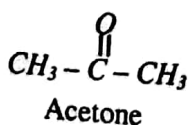


- ⑩ Functional Isomerism: Functional isomers have the same molecular formula but different functional groups.

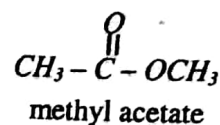
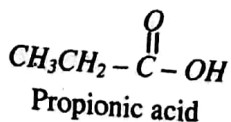
E.g. i) Ethyl alcohol and Dimethyl ether (C_2H_6O):



ii) Acetone and propionaldehyde (C_3H_6O):



- iii) Propionic acid and methyl acetate ($C_3H_6O_2$):



- ⑪ Metamerism: This type of isomerism is exhibited by the compounds having same functional groups but different alkyl groups attached to the same multivalent atom.

i) Metamers belong to the same homologous series.

E.g. $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{CH}_2 - \text{CH}_3$ Diethyl ether

$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{O} - \text{CH}_3$ Methyl-*n*-propyl ether

$\begin{array}{c} \text{H}_3\text{C} \\ \diagup \\ \text{CH} - \text{O} - \text{CH}_3 \\ \diagdown \\ \text{H}_3\text{C} \end{array}$ Methyl - iso propyl ether

- ⑫ Geometrical Isomerism: Geometrical isomerism results from a restriction of rotation about double bonds. The carbon atoms of the carbon - carbon double bond are sp^2 hybridized. The carbon - carbon double bond is made up of a σ bond and a π bond. The σ bond is formed by the overlap of sp^2 hybrid orbitals. The π bond is formed by the overlap of unhybridized p orbitals. The two carbon atoms of the $C = C$ bond and the four atoms that are attached to them all lie in one plane and their positions in space are fixed.

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PETROLEUM

Unrefined petroleum is obtained from ground or sea-deposits as 'crude oil'. It is a complex mixture of organic compounds. There are also small amounts of sulphur-containing compounds and compounds containing oxygen and nitrogen.

- ③. **Refining of Petroleum:** Petroleum is refined by fractional distillation. The huge fractionating tower allows different fractions to be collected, the lightest at the top and the heaviest at the bottom. The lighter fractions such as natural gas and gasoline, correspond to mixtures with low boiling points. The hydrocarbons with high boiling points are collected at bottom such as lubricating oils. The non-volatile materials are collected as residue.

The principle fractions obtained are:

- ❖ **Natural Gas:** The natural gas fraction is mainly methane and some ethane and small molecular weight hydrocarbons (propane and butane).
- ❖ **Gasoline:** The gasoline fraction contains hydrocarbons with 5 to 10 carbon atoms. It is in high demand as a motor fuel. Napthalene which has 10 carbon atoms, is a volatile solid used to make certain synthetic resins. The kerosene fraction contains hydrocarbons with 11–12 carbon atoms. Thermal cracking of the kerosene fraction gives smaller hydrocarbons.
- ❖ **Diesel Oil:** The heavier hydrocarbons contain 13 to 25 carbon atoms, making up the diesel oil fraction and heavy gas oil fractions.

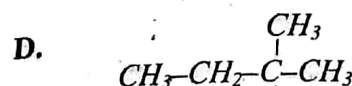
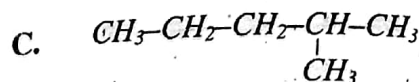
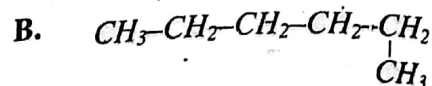
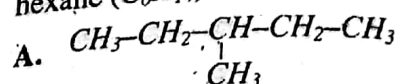
Catalytic cracking of the heavier fractions produces lightweight hydrocarbons. The process uses a temperature of about 500°C.

- ④. **Residue:** The residue contains the heaviest hydrocarbons, with more than 70 carbon atoms. The fraction is collected at the bottom of the column. These are non-volatile solids used as bitumen or asphalt.

SOME COMPONENTS OF PETROLEUM

No. of C per molecule	Fraction	Boiling pt. range of fraction °C
1 – 4	Natural gas	< 20
5 – 10	Petroleum gas (gasoline)	50 – 230
11 – 12	Kerosene (for jet- fuel)	175 – 325
	Gas oil	250 – 400
18 – 25	Heavy gas oil	350 – 430
> 70	Bitumen (asphalt)	> 500

- Q01. Which of these structures is not an isomer of hexane (C_6H_{14})?



- Q02. Which of these polymers is an addition polymer?

- A. Nylon
B. Protein
C. Bakelite
D. Polyethene

- Q03. The first organic compound synthesized from its elements was:

- A. Urea
B. Ethylene
C. Methane
D. Acetic acid

- Q04. Main source of organic compounds is:

- A. Coal tar
B. Petroleum
C. Both of these
D. None of the above

- Q05. What type of isomerism is shown by 1-propanol and 2-propanol?

- A. Chain isomerism
B. Position isomerism
C. Functional isomerism
D. Metamerism

- Q06. How many chain isomers are represented by C_5H_{12} ?

- A. 2
B. 4
C. 6
D. 3

- Q07. Olefinic double bond is the functional group of:

- A. Alkanes
B. Alkenes
C. Alkynes
D. None of the above

- Q08. The process in which many small molecules join together to form very large molecule is called:

- A. Isomerism
B. Catenation
C. Polymerization
D. Cracking

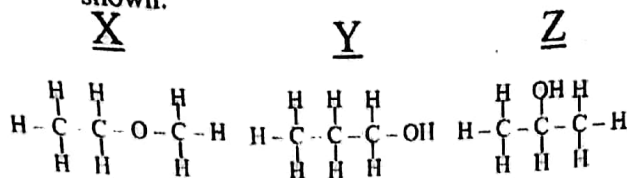
- Q09. All such compounds having open chain structure of carbon atoms are called:

- A. Aliphatic compounds
B. Alicyclic compounds
C. Carbocyclic compounds
D. Aromatic compounds

- Q10. Most of the hydrocarbons from petroleum are obtained by:
 A. Fractional crystallization
 B. Fractional distillation
 C. Vapourization
 D. Polymerization
- Q11. What is the maximum number of other atoms to an atom of carbon can be bonded in organic compounds:
 A. 1
 B. 2
 C. 4
 D. 6
- Q12. Which of the following is a heterocyclic compound:
 A. Benzene
 B. Pyridine
 C. Toluene
 D. Chlorobenzene
- Q13. An alkene with minimum number of carbon atoms showing isomerism, contain number of carbon atoms:
 A. 2
 B. 3
 C. 4
 D. 5
- Q14. Ethanol and dimethyl ether are:
 A. Position isomers
 B. Functional group isomers
 C. Chain isomers
 D. Metamers
- Q15. What continuous chain hydrocarbon is isomeric with 2-methyl 3-ethylhexane?
 A. Hexane
 B. Heptane
 C. Nonane
 D. Butane
- Q16. Closed chain compounds in which ring is made up of carbon atom along with some other atoms are called:
 A. Homocyclic
 B. Carbocyclic
 C. Heterocyclic
 D. Alicyclic
- Q17. Kerosene is composed of hydrocarbons containing how many carbon atoms?
 A. $C_2 - C_4$
 B. $C_5 - C_8$
 C. $C_6 - C_{10}$
 D. $C_{10} - C_{16}$
- Q18. A group of atoms in a compound that is responsible for the characteristic reactions is called:
 A. Reactive group
 B. Functional group
 C. Electrophilic group
 D. Nucleophilic group
- Q19. The isomers differ in the alkyl groups attached to a polyvalent atom or functional group except carbon, this type of isomerism is:
 A. Functional isomerism
 B. Position isomerism
 C. Metamerism
 D. Stereo isomerism
- Q20. Which type of isomerism is shown by: CH_3CH_2CHO & CH_3COCH_3 ?
 A. Position isomerism
 B. Metamerism
 C. Chain isomerism
 D. Functional isomerism

- Q21. The breaking of higher hydrocarbons into simple or lower gaseous hydrocarbons by heat is called:
 A. Cracking
 B. Pyrolysis
 C. Distillation
 D. Fractional distillation
- Q22. Which of the following is not the property of organic compounds:
 A. Characteristic property of catenation.
 B. The carbon present in organic compounds is always tetravalent.
 C. Most of the organic compounds possess high melting or boiling point.
 D. Isomerism is exhibited by organic compounds.
- Q23. Carbon atoms possess a great tendency to link with one another. This property of carbon is called:
 A. Isomerism
 B. Catenation
 C. Homologous series
 D. Polymerization
- Q24. Organic compounds containing same functional group can be arranged in a series known as:
 A. Homologous series
 B. Aliphatic chain
 C. Carbocyclic series
 D. Alicyclic chain
- Q25. An isomer of ethanol is:
 A. Diethyl ether
 B. Dimethyl ether
 C. Ethylene glycol
 D. Methanol
- Q26. The quality of petroleum is determined by:
 A. Knocking
 B. Fractional distillation
 C. Octane number
 D. Cracking
- Q27. On destructive distillation of 1000kg of coal, 50kg coal tar is formed. The destructive distillation of coal is called:
 A. Fermentation
 B. Carbonization
 C. Polymerization
 D. Cracking
- Q28. PVC is made by the polymerization of:
 A. Polyethylene
 B. Vinyl acetate
 C. Vinyl chloride
 D. Chloro benzene
- Q29. Which of the following is not an organic compound:
 A. CH_3-CH_3
 B. Urea
 C. CO_2
 D. CH_3OH
- Q30. Which one of the following is pure carbon compound:
 A. Coke
 B. Coal tar
 C. Coal gas
 D. All of the above
- Q31. Main source of organic compounds is:
 A. Coal tar
 B. Petroleum
 C. both A & B
 D. none of these
- Q32. Decomposition of organic compounds by heat alone is called:
 A. Cracking
 B. heat decomposition
 C. Knocking
 D. Ignition

Q33. The structures of three organic compounds are shown:



Which compounds are isomers of each other?

- A. X, Y and Z B. Y & Z only
 C. X and Z only D. none of them
- Q34. A hydrocarbon, containing 25 carbons could be:
- A. a volatile solid B. a non-volatile solid
 C. a gas D. a light oil
- Q35. In the fractional distillation of crude oil, which product has the lowest boiling point?
- A. Petrol B. Paraffin wax
 C. Bitumen D. Diesel
- Q36. Cycloalkanes have the general formula:
- A. C_nH_{2n+2} B. C_nH_{2n}
 C. C_nH_{2n-2} D. C_nH_{2n+4}
- Q37. The yield of organic reactions is generally poor because they are:
- A. accompanied by side reactions
 B. between covalent compounds
 C. Stoichiometric in nature
 D. Very fast
- Q38. The isomer of a substance must have the same:
- A. Chemical properties B. Physical properties
 C. molecular weight D. Structural formula
- Q39. Butane & isobutane are examples of:
- A. Chain isomerism
 B. Position isomerism
 C. geometrical isomerism
 D. functional isomerism
- Q40. The formula of a molecule showing how the various atoms are linked to each other is called a/an:
- A. Carbocyclic formula
 B. empirical formula
 C. molecular formula D. Structural formula
- Q41. An organic compound of the formula C_6H_{12} belongs to:
- A. Olefins B. alkynes
 C. alkenes D. alkanes
- Q42. How many isomeric butanes are there?
- A. 2 B. 3

- C. 4 D. 5
- Q43. Which of the following statements is correct about homologue?
- A. The molecular weight of every homologue differs by 14
 B. Homologues differ in their physical properties
 C. Homologues have the same functional group in them
 D. All of them
- Q44. Which of the following is a heterocyclic compound?
- A. Pyridine B. Benzene
 C. Chloro benzene D. Toluene
- Q45. The compound $C_4H_{10}O$ can show,
- A. metamerism
 B. Position isomerism
 C. functional isomerism
 D. all of these
- Q46. Organic compounds are very large in number because of:
- A. tetravalency of carbon
 B. Catenation
 C. ability of carbon to form multiple bond
 D. all the factors mentioned above
- Q47. Closed chain compounds in which ring is made up of carbon atom along with some other atom are called:
- A. homocyclic B. heterocyclic
 C. Carbocyclic D. alicyclic
- Q48. A homologue differs from its next higher or previous lower homologue in molecular masses by:
- A. 12 B. 14
 C. 16 D. 18
- Q49. The linking of two or more molecules of a substance to form a large single molecule is called:
- A. fusion B. Polymerization
 C. isomerism D. polymorphism
- Q50. All such organic compounds having open chain structure of carbon are called:
- A. aromatic B. aliphatic
 C. alicyclic D. carbocyclic

Topic 23

Chemistry Of Hydrocarbons

ALKANE, ALKENE & ALKYNE

ALKANE

- ② Hydrocarbons contain mainly carbon and hydrogen atoms. The simplest ones have single bonds only. These are alkanes.
- ② Alkanes form a homologous series with the general formula C_nH_{2n+2} (where n = number of carbon atom).
- ② These compounds are also known as saturated hydrocarbons.
- ② These are relatively inert towards most of the chemical reagents, so they are called paraffins (Latin; Parum, Little; affinis, affinity).
- ② In alkanes, each carbon carbon atom is in sp^3 hybridized state with its four bonding orbitals directed towards the four corners of a regular tetrahedron making a bond angle of $109^\circ 28'$. Every $C-H$ bond (bond length 1.09 \AA) or $C-C$ bond (bond length 1.54 \AA) is a strong sigma bond.
- ② Alkanes exhibit chain isomerism. The first three members (methane, ethane, propane) do not show isomerism because they have only one possible structure. The number of isomers in other alkanes increases with the increase in the number of carbon atoms.

THE IMPORTANCE OF ALKANES

The alkanes are particularly important because of their use as fuels. The first member of the series, methane, has long been known as 'marsh gas' (rotting organic matter trapped in stagnant water gives off the gas) and 'fire damp' in coal mines. It is also produced from decaying animal dung and from raffish rubbish underground. Methane is trapped in huge quantities underground in areas where oil is found.

Methane can be pumped directly from the deposits via pipelines into homes and factories, where it is often known as 'natural gas'.

Methane is odourless, so for the reasons of safety, traces of a foul smelling chemical are usually added to natural gas.

Many hydrocarbons are extracted by the distillation of crude oil in an oil refinery. The lighter,

low boiling point hydrocarbons are collected from the top of distillation column and the heavier ones from the various stages lower down. The mixtures of hydrocarbons removed at each stage are called 'fractions'. Each fraction has its own set of uses.

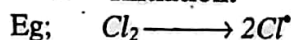
PRODUCTS OF THE FRACTIONAL DISTILLATION OF OIL

NAME OF FRACTION	BOILING RANGE / °C	USE
Gases	< 30	Sources of propane and butane for fuels; feedstock for chemical industry.
Gasoline	30 - 75	Petrol manufacture
Naptha	75 - 190	Feedstock for chemical industry
Kerosene	190 - 250	Aircraft fuel, central heating boiler fuel.
Gas oil	250 - 350	Diesel fuel, central heating boiler fuel.
Waxes, tars, heavy oils, asphalt	> 350	Polishes, lubricants, specialised fuels e.g. for power stations.

THE REACTIONS OF ALKANES

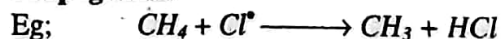
- ② **Combustion:** They all burn in air or oxygen.
- ② **Halogenation:** They give substitution reaction with halogens. The reaction with halogens is of free radical type. For example, the reaction between an alkane and chlorine is explosive if light (especially ultraviolet light) shines on the mixture. If the mixture is kept in the dark, no reaction takes place. A free radical reaction takes place in three stages.

✧ Initiation:



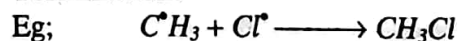
This is the stage that is caused by the ultraviolet light. The energy of the photons in the light must be sufficient to break the bond between the halogen atoms.

✧ Propagation:



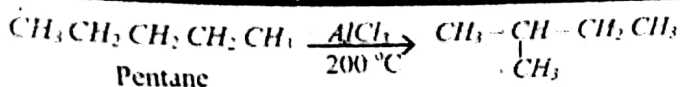
In the propagation stage, a radical may be used up, but another one takes its place.

✧ Termination:



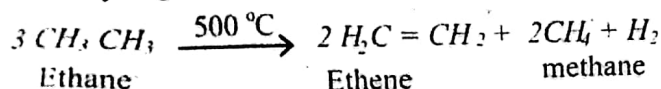
Here, radicals are removed from the reaction.

- ② **Isomerisation or Reforming:** Normal alkanes are converted to their branched chain isomers in the presence of $AlCl_3$ and HCl . The middle fractions of petroleum contain straight chain alkanes. (predominantly) and they are isomerised or reformed by passing over $AlCl_3$ catalyst at $200^\circ C$.



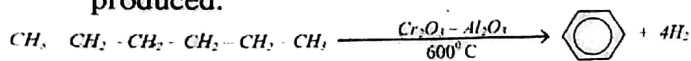
Pentane

- ③. **Cracking:** The decomposition of a compound by heat is called pyrolysis. This process when applied to alkanes is known as cracking. When alkanes are heated to a high temperature in the absence of air, a thermal decomposition occurs, large alkane molecules are broken down into a mixture of smaller, lower molecular weight alkanes, alkenes and hydrogen.



- ④. **Aromatisation:** Alkanes containing 6 to 10 carbon atoms are converted into benzene and its homologues at high temperature and in the presence of catalyst.

For e.g.; when *n*-hexane is passed over Cr_2O_3 supported over alumina at 600°C , benzene is produced.



- ⑤. **Octane Number:** Octane number of a gasoline is the percentage of iso-octane present in a mixture of iso-octane and *n*-heptane which match the fuel (gasoline) in knocking. Higher the octane number of fuel, the higher is its antiknock property and better is its quality. Aviation (in aeroplanes) gasoline has an octane number above 100.

- ⑥. **Knocking:** It is the objectionable metallic sound produced during the working of an internal combustion engine, it leads to the wastage of fuel. Knocking may be prevented by adding antiknock compound such as tetraethyl lead (TEL). This fluid is a mixture of TEL (60%), ethylene bromide (26%), ethylene chloride (9%) and a red dye (2%). About 1 to 3 ml ethyl fluid is sufficient for one gallon of petrol.

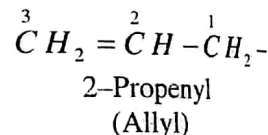
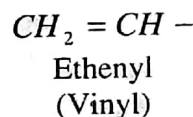
PHYSICAL PROPERTIES OF ALKANES

- ⑦. First four members of the series are colourless, odourless gases.
- ⑧. From pentane to heptadecane are colourless, odourless liquids.
- ⑨. Higher alkanes are colourless solids.
- ⑩. These are insoluble in water but soluble in organic solvents. However, their solubility decreases with increase in their molecular weight.

- ⑪. In case of normal paraffins, the boiling points increase with increase in the number of carbon atoms due to the increase in Vander waal's forces.
- ⑫. Among the isomeric alkanes, the straight chain (normal) isomer has higher boiling point than the branched chain isomer. The greater the branching of the chain, the lower is the boiling point.
- ⑬. Normal alkanes with an even number of carbon atoms have slightly higher melting point than the next higher homologue containing odd number of carbon atoms.

ALKENE

- ⑭. Alkenes are the hydrocarbons that contain a carbon-carbon double bond in their molecule.
- ⑮. Alkenes have general formula C_nH_{2n} (where n = number of carbon atom).
- ⑯. These are unsaturated hydrocarbons.
- ⑰. These are also known as olefins (olefiant = oil forming) because the first member, ethene, forms an oily product with chlorine.
- ⑱. **Alkenyl Group:** The monovalent groups obtained by the removal of one hydrogen atom from alkenes are called alkenyl groups.



CHEMICAL REACTIONS OF ALKENES

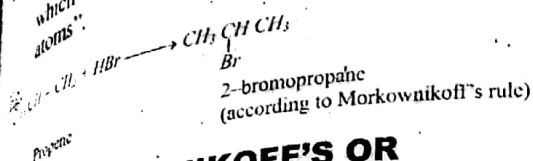
- ⑲. The double bond in alkenes consists of a strong sigma and weak π bond. The π electrons constituting the π bond are less firmly held by the carbon nuclei and are easily available to the electrophilic reagents. Thus, olefinic double bonds behave as nucleophiles in their addition reactions. The characteristic reactions of alkenes are electrophilic addition reactions.
- ⑳. In alkenes, addition of hydrogen, halogen, hydrogen halide, hypohalous acid and H_2SO_4 takes place.
- ㉑. Alkenes on addition of O_2 form epoxides.
- ㉒. The process of addition of ozone to alkene to form an ozonide and then to hydrolyse the product is called ozonolysis.

MORKOWNIKOFF'S RULE

- ㉓. "When an unsymmetrical reagent (e.g. H_2SO_4 , HOCI) adds to an unsymmetrical alkene, then the negative part of the reagent is

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added to that carbon atom of the double bond which contains the least number of hydrogen atoms".



ANTI-MARKOWNIKOFF'S OR KHARASCH PEROXIDE EFFECT

Addition of HBr to propene in the presence of air, peroxide or light yields mainly n-propyl bromide i.e. the reagent adds to the olefin contrary to Markownikoff's rule.

PHYSICAL PROPERTIES OF ALKENE

The first three members of alkene series (ethene, propene and butene) are gases at ordinary temperature; the next fourteen members are liquids and the higher alkenes are solids.

They are all colourless and odourless, except ethene which has a rather pleasant odour.

Alkenes are only slightly soluble in water but dissolve freely in organic solvents.

Their boiling points, melting points in general rise with increases of molecular weight in the homologous series.

Dienes, Diolefins or Alkadienes

Compounds containing two double bonds in a molecule are called dienes or diolefins.

When two double bonds are present on the adjacent carbon atoms, the diene is known as "cumulative diene".

When the two double bonds are separated by one single bond, the diene is known as "conjugated diene".

When the two double bonds are separated by more than one single bond, the diene is called isolated diene.

ALKYNE

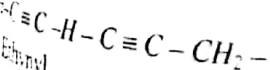
Alkynes are the hydrocarbons that contain a carbon-carbon triple bond in their molecule.

Alkynes have general formula C_nH_{2n-2} (where n = number of carbon atoms).

These are unsaturated hydrocarbons.

Alkynyl Radical: The group or radical obtained by the removal of one hydrogen atom of an alkyne is called alkynyl group.

Eg:



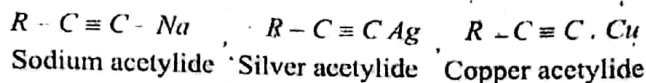
Ethynyl

2-Propynyl

Acidity of Alkynes: Acetylene and 1-alkyne are acidic in nature because they readily donate

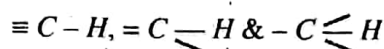
protons to strong bases. The hydrogen atom joined to $-\text{C}\equiv\text{C}-$ is acidic and can be substituted to give metallic derivatives called acetylides or alkynides.

Eg:



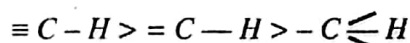
- ③ **Cause of Acidity:** The acidity of 1-alkynes can be explained on the basis of molecular orbital concept according to which the formation of $\text{C}-\text{H}$ bonds in acetylene involves sp -hybridized carbon atom. Since s -electrons are closer to the nucleus than p -electrons, the electrons present in a bond having more s -character will be closer to the nucleus.

The amount (%) of s character

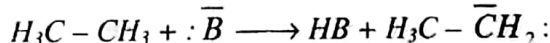
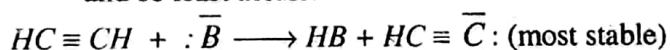


bond is 50%, 33.3 % and 25% respectively.

"Thus, due to high s character (50%) of $\text{C}-\text{H}$ bond in alkynes, the electrons forming this bond are more tightly held by the carbon nucleus (ie. Acetylenic carbon atom or sp orbital acts as more electronegative species than sp^2 and sp^3). So, the hydrogen present on such a carbon atom ($\equiv\text{C}-\text{H}$) can be easily removed as a proton. The acidic nature of three types of $\text{C}-\text{H}$ bonds follow the order:



- ④ **Anion Of Acetylene Is Most Stable:** (because sp carbon is most electronegative) and hence most acidic while anion of ethane is least stable (sp^3 carbon is least electronegative) and so least acidic.



(least stable)

- ⑤ **Addition Reactions:** Alkyne show addition reactions with reagents like halogen, halogen acids, hypohalous acids, water, hydrogen cyanide, sulphuric acid.

- ⑥ **Cyclic Polymerisation:** Alkynes, when passed through a red hot iron tube, undergo cyclic polymerisation to form aromatic hydrocarbon.

3 molecules of acetylene polymerise to give benzene molecule. Similarly, 3 molecules of propyne polymerises to give 1,3,5-trimethylbenzene or mesitylene.

PHYSICAL PROPERTIES OF ALKYNE

- ③ First four alkyne members are gases.

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- ⊙. Next nine members are liquids.
 ⊙. Higher members are solids.
 ⊙. These are colourless and odourless. However, acetylene has garlic odour due to the presence of impurities like H_2S , PH_3 etc.
 ⊙. Alkynes are sparingly soluble in water but dissolve in organic solvents like acetone, alcohol etc.
 ⊙. Acetylene liquefies at $-84^\circ C$ under ordinary pressure.
 ⊙. Since liquid acetylene is dangerously explosive, it is stored and transported in acetone solution.

EXERCISE

- Q01. Which of these is not an unsaturated molecule?
 A. C_4H_6 B. C_6H_6
 C. C_8C_{18} D. C_3H_6
- Q02. $C_3H_8 + Cl_2 \xrightarrow{\text{Light}} C_3H_6Cl_2 + 2HCl$ is an example of:
 A. Addition reaction
 B. Oxidation reaction
 C. Substitution reaction
 D. Elimination reaction
- Q03. Reaction with a double bond gives which type of reaction?
 A. Addition reaction
 B. Oxidation reaction
 C. Substitution reaction
 D. Elimination reaction
- Q04. The IUPAC name of the following compound is:

$$\begin{array}{c} CH \\ | \\ CH_3-CH-CH-CH_2-CH_2-CH_3 \\ | \\ CH_2-CH_3 \end{array}$$

 A. 3-methyl-3-ethylheptane
 B. 3-ethyl-2-methylhexane
 C. 3-methyl-3-ethylheptane
 D. 4-methyl-3-ethylheptane
- Q05. A photochemical reaction which is catalyzed by the presence of:
 A. Ni B. Pt
 C. Sunlight D. $FeCl_3$
- Q06. In the laboratory, ethane is prepared by the reaction called:
 A. Sabatier-Senderens reaction
 B. Halogenation
 C. Hydrohalogenation
 D. Reduction of alkyl halide

Chemistry Of Hydrocarbons

- Q07. From the formulas listed below, select an example of primary amine:
 A. $(CH_3)_2 C/H CH_2 NH_2$
 B. $(CH_3)_2 N CH (CH_3)_2$
 C. $CH_3 CH OH CH_2 NH CH_3$
 D. $(CH_3)_3 N$
- Q08. The compound 'A' has the formula C_4H_8 . Which does not react with bromine, the possible structure for compound A is:
 A. $CH_2 = CH - CH_2 - CH_3$
 B. $CH_3 - CH = CH - CH_3$
 C. $H_2C - CH_2$

$$\begin{array}{c} | \\ H_2C - CH_2 \end{array}$$

 D. $CH_3 - CH_2 - CH = CH_2$
- Q09. Which class of compounds is represented by the type formula ROR?
 A. Aldehyde B. Ether
 C. Ester D. Ketone
- Q10. The negative part of the addendum adds on to the carbon atom joined to the least number of hydrogen atoms. The statement is called:
 A. Markownikoff's rule
 B. Peroxide effect
 C. Elimination reaction
 D. Baeyer's theory
- Q11. The name butanol is not specific, which of the following name represents a specific compound:
 A. Pentanone B. Butanal
 C. Butene D. Butyl chloride
- Q12. Which of the following hydrocarbon have the same general formula:
 A. Alkane & Alkene
 B. Alkene & Alkynes
 C. Alkene & Dienes
 D. Alkene & Cycloalkane
- Q13. Which of the following statement is correct about hydrocarbons:
 A. Alkene having less than two carbon atom is not possible.
 B. Alkene is also called as parafins.
 C. General formula of alkene is C_nH_{2n-2}
 D. If unsaturated hydrocarbons contain triple bond between carbon-carbon atom, then it is called alkene.
- Q14. The IUPAC name of the following compound is:

$$CH_2 = C - CH_2 - CH_3$$

$$\begin{array}{c} | \\ CH - CH_3 \\ | \\ CH_3 \end{array}$$

 A. 2-isopropyl-1-butene
 B. 2-ethyl-3-methylbutene
 C. 2-methyl-3-ethylbutene
 D. 2-methyl-2-ethylbutene

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- Q15. The correct secondary amine:
 A. 3° amine
 B. 1° amine
 C. 2° amine
 D. 3° amine
- Q16. Hydrocarbon bonds between called:
 A. Saturated
 B. Unsaturated
 C. Aromatic
 D. Aromatic
- Q17. The IUPAC name of Ethene:
 A. Ethene
 C. Propyne
- Q18. General formula of alkene:
 A. C_nH_{2n}
 C. C_nH_{2n-2}
- Q19. When a mixture of ethene and ethane is passed over a catalyst at $250^\circ C$, which compound is formed:
 A. Ethene
 C. Ethane
- Q20. With the help of this method, the salt of potassium permanganate is formed:
 A. Frank
 B. Sabatier
 C. Kolbe
- Q21. At ordinary temperature, the alkenes are:
 A. Vicinal
 C. Alkanes
- Q22. Carbon-carbon bond length in ethane is $1.20^\circ A$ and in ethene is $1.08^\circ A$, which is shorter:
 A. SP^3
 C. SP
- Q23. Hydrogenation of ethene:
 A. Acid
 C. Neutral
- Q24. Formation of alkyl halide is called:
 A. Cannizzaro
 B. Friedel-Crafts
 C. Wurtz-Fittig
- Q25. Ethyl alcohol is the product of:
 A. Ethene
 B. C_3H_8
 C. C_2H_6

- Q15. The correct order of basic nature of primary, secondary and tertiary amines is:
- 3° amine $>$ 2° amine $>$ 1° amine
 - 1° amine $>$ 2° amine $>$ 3° amine
 - 2° amine $>$ 1° amine $>$ 3° amine
 - 3° amine $>$ 1° amine $>$ 2° amine
- Q16. Hydrocarbons with double or triple covalent bonds between any two carbon atoms are called:
- Saturated hydrocarbons
 - Unsaturated hydrocarbons
 - Aromatic compounds
 - Alkanes
- Q17. The IUPAC name for acetylene is:
- Ethene
 - Ethyne
 - Propyne
 - 2-butyne
- Q18. General formula of saturated hydrocarbon is:
- $C_nH_{2n}O$
 - $C_nH_{2n+1}OH$
 - C_nH_{2n+2}
 - C_nH_{2n-2}
- Q19. When a mixture of CO and H_2 is passed over a catalyst containing Ni and carbon at $250^\circ C$, which of the following product is formed:
- Ethene
 - Methane
 - Ethane
 - Ethyne
- Q20. With the electrolysis of aqueous solution of salt of potassium acetate, ethane is obtained, this method is:
- Frankland reaction
 - Sabatier senderen's method
 - Kolbe's method
 - None of the above
- Q21. At ordinary temperature, halogens added to the alkenes form:
- Vicinal dihalides
 - Alkyl halides
 - Alkanes
 - Vinyl halide
- Q22. Carbon-carbon bond length in alkyne is $1.20^\circ A$ and carbon-hydrogen bond length is $1.08^\circ A$, hybridisation is alkyne is:
- SP^3
 - SP^2
 - SP
 - $d^2 SP^3$
- Q23. Hydrogen atom of acetylene are:
- Acidic
 - Basic
 - Neutral
 - Amphoteric
- Q24. Formation of alkane by the action of Zn on alkyl halide is called:
- Cannizaro's reaction
 - Frankland reaction
 - Wurtz reaction
 - Kolbe's reaction
- Q25. Ethyl alcohol is heated with conc. H_2SO_4 , the product formed is:
- $H_3C - \underset{\text{O}}{\underset{\parallel}{C}} - OC_2H_5$
 - C_3H_6
 - C_2H_4
 - C_2H_2

- Q26. Which has least carbon-carbon bond length:
- Ethane
 - Ethene
 - Ethyne
 - Benzene
- Q27. Final product on the oxidation of hydrocarbon is:
- Aldehyde
 - $H_2O + CO_2$
 - Acid
 - Alcohol
- Q28. The combination of two carbon atoms in ethane results from the overlap of two:
- SP orbitals
 - SP^3 orbitals
 - SP^2 orbitals
 - S orbitals
- Q29. What happens when propane is treated with HBr in the presence of peroxide:
- n-propyl bromide is formed
 - 1,2 dibromopropane is formed
 - Propylene chloride is formed
 - None of these
- Q30. Markownikoff rule is useful in predicting the product of a reaction between an alkene and:
- H_2
 - Br_2
 - HBr
 - O_3
- Q31. Which statements about butene is not correct?
- it decolourises aqueous bromine
 - it is generally unreactive
 - it is a hydrocarbon
 - it is a monomer of polyethene
- Q32. Which of the following gases gives a red precipitate with an ammonical solution of cuprous chloride:
- acetylene
 - ethylene
 - ethane
 - Propylene
- Q33. The hydrocarbon C_3H_6 must have:
- all single bonds
 - one double bond
 - one triple bond
 - two double bonds
- Q34. Polymerization of acetylene results in the formation of:
- benzene
 - ethane
 - ethylene
 - toluene
- Q35. Name the hydrocarbon that is a liquid as S.T.P.:
- ethane
 - Propane
 - n-butane
 - n-Pentane
- Q36. Ammonical silver nitrate solution reacts with acetylene to form:
- Silver acetate
 - Silver acetylide
 - Silver formate
 - a silver mirror
- Q37. Marsh gas contains a large proportion of:
- acetylene
 - ethane
 - ethylene
 - methane
- Q38. Ethylene reacts with conc. H_2SO_4 to give:
- acetaldehyde
 - acetylene
 - ethyl hydrogen sulphate
 - formaldehyde


- Q39. Which of the following gases is used for welding?
 A. acetylene B. ethane
 C. ethylene D. methane
- Q40. Give the antiknock agent used in gasoline:
 A. diethyldimethyl lead
 B. ethyltrimethyl lead
 C. tetraethyl lead
 D. triethylmethyl lead
- Q41. Ethylene reacts with alkaline $KMnO_4$ to form:
 A. acetaldehyde B. ethylene glycol
 C. ethylene oxide D. formaldehyde
- Q42. The Product 'X' in the following reaction is:
 $CH_3 - CH = CH_2 + HBr \longrightarrow X$
 A. $CH_3 - CH_2 - CH_2 - Br$
 B. $CH_2 - \underset{\text{Br}}{\underset{|}{CH}} - CH_3$
 C. $\underset{\text{Br}}{\underset{|}{CH_2}} - CH = CH_2$
 D. $CH_3 - H_2C - CH_3$
- Q43. The reaction, $2RX + 2Na \longrightarrow R - R + 2NaX$ is an example of:
 A. Cannizzaro's reaction
 B. Kolbe's reaction
 C. Sabatier & sandereen's reaction
 D. Wurtz reaction
- Q44. Acetylene on reduction yields:
 A. alkane B. alcohol
 C. acetaldehyde D. Acetone
- Q45. Baeyer's test is not applicable to:
 A. alkyne B. alkene
 C. both of these D. none of these
- Q46. The process yielding ethene, methane and H_2 from ethane is:
 A. Cracking B. Pyrolysis
 C. reduction D. addition
- Q47. The solution used for the purification of acetylene is:
 A. $CuSO_4$ solution
 B. Baeyer's reagent
 C. Silver nitrate solution
 D. none of the above
- Q48. The molecular formula of a product formed by the reaction between propane and chlorine in light could be:
 A. $C_3H_5Cl_2$ B. $C_3H_7Cl_2$
 C. C_3H_7Cl D. $C_3H_3Cl_4$
- Q49. Which compound is reacted with water, in the presence of a catalyst and under high pressure, to make industrial ethanol:
 A. ethane B. ethene
 C. ethyne D. ethanal
- Q50. Which type of reaction occurs between ethene and hydrogen?
 A. addition B. oxidation
 C. substitution D. reduction
- Q51. By the action of water on methyl magnesium bromide, is obtained:
 A. CH_4 B. C_2H_6
 C. CH_3OH D. C_2H_5OH
- Q52. Compounds with maximum percentage of hydrogen is:
 A. C_2H_2 B. C_6H_6
 C. C_2H_4 D. CH_4
- Q53. The reaction conditions leading to the best yields of C_2H_5Cl are:
 A. $C_2H_6(\text{excess}) + Cl_2 \xrightarrow{u.v \text{ Light}}$
 B. $C_2H_6 + Cl_2 \xrightarrow{\text{dark}}$
 C. $C_2H_6 + Cl_2(\text{excess}) \xrightarrow{u.v \text{ Light}}$
 D. $C_2H_6 + Cl_2 \xrightarrow{u.v \text{ Light}}$
- Q54. By which of the following processes can acetic acid be converted into methane?
 A. Dehydrogenation B. Dehydration
 C. Decarboxylation D. Polymerization
- Q55. When aluminium carbide is hydrolyzed, gas produced is:
 A. C_2H_2 B. CH_4
 C. C_2H_4 D. C_6H_6
- Q56. Ethylene belongs to the class:
 A. alkynes B. Paraffins
 C. Olefins D. Amines
- Q57. A gas does not give any precipitate with ammonical $AgNO_3$ but decolourises alkaline $KMnO_4$. The gas may be:
 A. C_2H_6 B. C_2H_4
 C. C_2H_2 D. C_3H_8
- Q58. Which of the following displaces hydrogen on reaction with sodium?
 A. CH_4 B. C_2H_6
 C. C_2H_4 D. C_2H_2
- Q59. Hydrogen atoms are most acidic in:
 A. ethane B. ethene
 C. ethyne D. benzene
- Q60. The hybridization of carbon atoms in C-C single bond of $HC \equiv C - CH = CH_2$ is:
 A. $sp^3 - sp^3$ B. $sp^2 - sp^3$
 C. $sp - sp^2$ D. $sp^3 - sp$

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Aromatic Compounds

BENZENE

- ⑧ Aromatic hydrocarbons are also known as arenes.
- ⑧ Benzene is the simplest aromatic hydrocarbon.
- ⑧ Benzene derivatives can be monosubstituted, disubstituted or polysubstituted.
- ⑧ A monosubstituted benzene is a benzene with one substituent.
- ⑧ A disubstituted benzene is a benzene with two substituents.
- ⑧ A polysubstituted benzene is a benzene with three or more substituents.
- ⑧ Benzene has a cyclic, planar, hexagonal structure.
- ⑧ All hydrogen are equivalent. If a hydrogen is substituted by another group, it does not matter which hydrogen is replaced. Only one product is formed.
- ⑧ All carbon atoms in benzene are sp^2 hybridized.
- ⑧ All carbon-carbon bond lengths are identical and are intermediate between normal $C - C$ single bonds and $C = C$ double bonds.
- ⑧ Benzene does not have alternate single and double bonds.
- ⑧ According to resonance theory, the true structure of benzene is a hybrid 
- ⑧ Resonance hybrid is more stable than any of its contributing structures.
- ⑧ For benzene, the stability due to resonance is so great that π -bonds of the molecule will normally resist breaking. This explains lack of reactivity of benzene towards addition.
- ⑧ Benzene gives substitution reactions in which the stability of benzene ring is preserved.
- ⑧ Benzene normally undergoes electrophilic substitution reactions.
- ⑧ The substitution reactions of benzene always takes place in the presence of catalyst.
- ⑧ Substituted benzene also undergo electrophilic substitution reaction. There are three possible products that can form when a second substituent is introduced. Experimentally, one or two of the isomers are preferentially formed.
- ⑧ The substituent already present in the ring determines where further substitution occurs. It also affects the rate at which substitution occurs.
- ⑧ A substituent that directs an incoming group to the ortho and para positions is called an ortho, para director (*o,p*-director).

- ⑨ A substituent that directs an incoming group to the meta position is called meta director.
- ⑨ A substituent that makes benzene ring more reactive towards electrophilic substitution than benzene itself is called activating group.
- ⑨ A substituent that makes benzene ring less reactive towards electrophilic substitution reaction than benzene itself is called Deactivating group.
- ⑨ All *o,p*-directors are ring activating groups. Halogens are exceptions. They are *o,p*-directors but deactivating.
- ⑨ All meta directors are ring deactivating groups.

ALKYL BENZENE

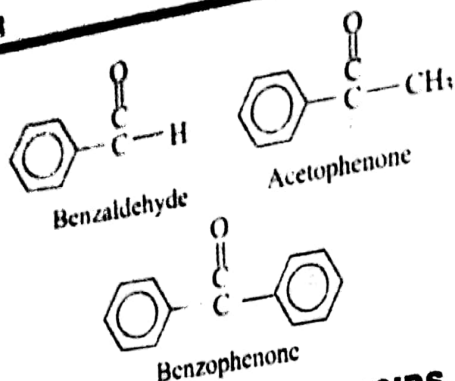
- ⑨ Alkyl benzene contains alkyl group(s) attached directly to an aromatic ring.
- ⑨ Toluene is the simplest alkyl benzene.
- ⑨ All alkyl benzenes on oxidation with hot $KMnO_4$, $K_2Cr_2O_7$ give benzoic acid. The length of the side chain does not matter. The product is always benzoic acid.

AROMATIC HALOGEN COMPOUNDS

- ⑨ Aromatic halogen compounds contain halogen attached directly to an aromatic ring.
- ⑨ Aromatic halogen compounds are named as derivatives of the parent hydrocarbon. The halogen atom is considered as a substituent.
- ⑨ Benzyl chloride $C_6H_5CH_2Cl$ and other similar compounds in which halogen atom is not attached directly to the ring are called side-chain aromatic halides. They have properties of alkyl halides.
- ⑨ Halogenation is a process of substituting one or more hydrogen atoms in a molecule by the corresponding number of hydrogen atoms.
- ⑨ Chlorobenzene and bromobenzene can be prepared by direct halogenation of benzene in the presence of Lewis acid as catalyst.
- ⑨ Iodobenzene cannot be prepared by direct iodination. It is obtained by treatment of benzene diazonium chloride with potassium iodide.
- ⑨ Chlorobenzene is less reactive than benzyl chloride.

AROMATIC ALDEHYDES & KETONES

- ⑨ Aromatic aldehydes are the compounds in which $-CHO$ group is attached to an aromatic ring.
- ⑨ Aromatic ketones are the compounds in which a carbonyl group is attached to either two aryl groups or one alkyl group and one aryl group.
- ⑨ Benzaldehyde is an important aromatic aldehyde.
- ⑨ Acetophenone and Benzophenone are important aromatic ketones.



AROMATIC CARBOXYLIC ACIDS

- Ⓐ Aromatic carboxylic acids are the compounds in which a carboxyl group ($-COOH$) is attached directly to an aromatic ring.
- Ⓑ Aromatic carboxylic acids are usually named by common names or as derivatives of the parent benzoic acid.
- Ⓒ Phenylacetic acid ($C_6H_5CH_2COOH$) and other similar compounds in which the carboxyl group is not attached directly to the ring are called side-chain aromatic carboxylic acids.

AROMATIC SULPHONIC ACID

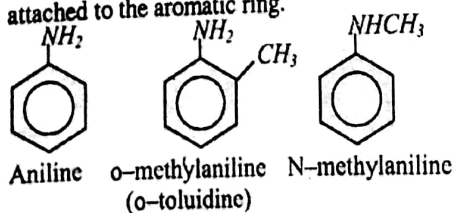
- Ⓐ Aromatic sulphonic acids contain $-SO_3H$ group attached directly to an aromatic ring.
- Ⓑ Benzene sulphonic acid is the simplest aromatic sulphonic acid.

AROMATIC NITRO COMPOUNDS

- Ⓐ Aromatic nitro compounds contain $-NO_2$ group attached directly to an aromatic ring.
- Ⓑ Nitrobenzene is the simplest aromatic nitro compound.

AROMATIC AMINES

- Ⓐ Aromatic amines are the compounds in which nitrogen atom is attached directly to an aromatic ring.
- Ⓑ Aromatic amines are named as derivatives of aniline.
- Ⓒ Alkyl or other groups can be attached to both the aromatic ring and to the nitrogen. Therefore, to distinguish between the two types of group locations, N is placed in front of the groups attached to nitrogen and a number before those attached to the aromatic ring.



- Ⓓ Benzylamine $C_6H_5CH_2NH_2$ and other simpler compounds in which the nitrogen atom is not

attached directly to the ring are called side-chain aromatic amines. They have properties of aliphatic amines.

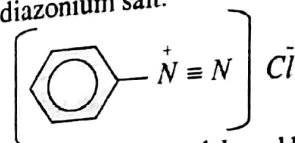
PHENOL

- Ⓐ Phenols are the compounds which contain $-OH$ group attached directly to an aromatic ring.
 - Ⓑ Many phenols have special common names.
 - Ⓒ Benzyl alcohol $C_6H_5CH_2OH$ and other similar compounds in which the $-OH$ group is attached to the side-chain are known as aromatic alcohol.
 - Ⓓ Phenols are stronger acids than alcohol i.e. they ionize more readily to produce H^+ ion.
 - Ⓔ Compared to acetic acid, phenol is a weaker acid.
- Acidity: $\text{acetic acid} > \text{phenol} > ROH > HOH$
 decreasing acidity

- Ⓕ The sodium salt of phenol is called sodium phenoxide.

DIAZONIUM SALTS

- Ⓐ Aromatic diazonium salts contain a diazonium group ($-N \equiv N^+$) attached to an aryl group.
- Ⓑ Benzene diazonium chloride is the simplest aromatic diazonium salt.



- Ⓐ Diazonium salts are named by adding the word diazonium to the name of aryl group followed by the name of the anion.
- Ⓑ Preparation of a diazonium salt from a primary aromatic amine is called Diazotisation.
- Ⓒ Reactions of benzene diazonium chloride are divided into two types:
 - Replacement reaction in which $-N_2Cl$ group is replaced by another functional group.
 - Reactions in which the nitrogen atoms are retained.

EXERCISE

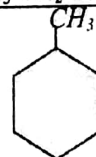
Q01. Nitration of benzene is a:

- Nucleophilic substitution reaction
- Electrophilic substitution reaction
- Electrophilic addition reaction
- Nucleophilic addition reaction

Q02. Which of the following is an aromatic compound?

- CH_3CH_2Br
- $CH_3CH_2CH_2CH_3$

C.



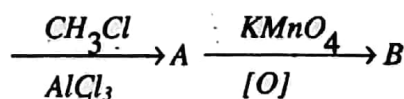
D.



Chemistry

- Q03. The carbon atoms in benzene are:
 A. sp^3 hybridized B. sp^2 hybridized
 C. sp hybridized D. None of these
- Q04. The total number of sigma bonds in benzene are:
 A. 6 B. 12
 C. 18 D. 3
- Q05. The π molecular orbital in benzene contains:
 A. 2 electrons B. 4 electrons
 C. 6 electrons D. 3 electrons
- Q06. The $C-C-C$ bond angles in benzene are:
 A. 120° B. 90°
 C. 109.28° D. 180°
- Q07. The carbon-carbon bond length in benzene is:
 A. longer than a $C-C$ single bond
 B. longer than a $C=C$ double bond
 C. Shorter than a $C=C$ double bond
 D. Shorter than a $C\equiv C$ triple bond
- Q08. Two adjacent substituents on benzene ring is said to be:
 A. Ortho to one another
 B. Meta to one another
 C. Para to one another D. None of the above
- Q09. Benzene reacts with a mixture of conc. HNO_3 + H_2SO_4 to form:
 A. Phenol B. Benzene sulphonic acid
 C. Nitrobenzene D. Toluene
- Q10. Aromatic hydrocarbons are also called:
 A. Benzene B. Arenes
 C. Cyclic compounds D. None of the above
- Q11. The attacking species in aromatic substitution reaction is:
 A. A nucleophile B. An electrophile
 C. A free-radical D. None of the above
- Q12. Benzene undergoes nitration with conc. HNO_3 in the presence of:
 A. $AlCl_3$ B. $dilH_2SO_4$
 C. conc. H_2SO_4 D. $dilHCl$
- Q13. What happens when benzene is treated with acetyl chloride in the presence of $AlCl_3$?
 A. Nitrobenzene is formed
 B. Bromo benzene is formed
 C. Chlorobenzene is formed
 D. Acetophenone is formed
- Q14. Benzene reacts with methyl chloride in the presence of $AlCl_3$ to form:
 A. Toluene B. Chloro benzene
 C. m-dichloro benzene D. Nitrobenzene
- Q15. Chlorination of benzene is:
 A. An electrophilic substitution reaction
 B. A nucleophilic substitution reaction
 C. A free-radical reaction
 D. An elimination reaction

- Q16. Benzene reacts with methyl chloride in the presence of $AlCl_3$ to form:
 A. Benzyl chloride B. Chloro benzene
 C. Benzendiazonium chloride
 D. All of the above
- Q17. What happens when phenol is distilled with Zn dust:
 A. Benzene is formed B. Toluene is formed
 C. Acetylene is formed D. None of the above
- Q18. The $-CH_3$ group is:
 A. Ortho directing only
 B. Meta directing only
 C. Para directing only
 D. Both ortho and para directing
- Q19. Toluene undergoes oxidation with hot acidic $KMnO_4$ to form:
 A. Benzoic acid B. Benzyl alcohol
 C. Benzyl chloride D. Benzaldehyde
- Q20. Benzene reacts with chlorine in the presence of $FeCl_3$ to form:
 A. m-dichlorobenzene B. Chlorobenzene
 C. Benzyl chloride D. dichlorobenzene
- Q21. The $-SO_3H$ group is:
 A. Ortho directing only B. Para directing only
 C. Meta directing only
 D. Both ortho and para directing
- Q22. How will you convert benzene into benzene sulphonic acid?
 A. Benzene is heated with conc. HNO_3
 B. Benzene is heated with conc. H_2SO_4
 C. Benzene is heated with $dil H_2SO_4$
 D. None of the above
- Q23. The $-COOH$ group in benzoic acid is:
 A. Both ortho & para directing
 B. Ortho directing only
 C. Meta directing only D. Para directing only
- Q24. Identify 'A' & 'B' in the following reaction sequence:



- A. A = Benzoic acid B. A = Toluene
 B = Toluene B = Benzoic acid
- C. A = Sodium benzoate D. A = Toluene
 B = Benzoic acid B = Ethyl benzoate
- Q25. Coal tar is the main source of:
 A. Aliphatic compounds
 B. Aromatic compounds
 C. Cycloalkanes
 D. Heterocyclic compounds
- Q26. Which one of following is a diazonium salt?
 A. $C_6H_5N_2Cl$ B. $C_6H_5NH_2HCl$
 C. C_6H_5ONa D. C_6H_5COONa

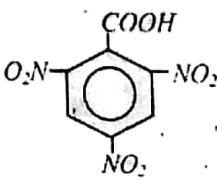
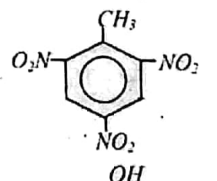
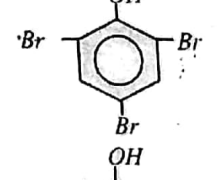
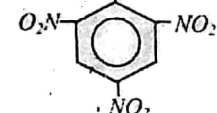
Q27. Bakelite is obtained from phenol by reacting with:

- A. Acetaldehyde B. Acetal
C. Formaldehyde D. Chlorobenzene

Q28. On distilling with Zinc dust, phenol gives:

- A. benzaldehyde B. benzene
C. benzoic acid D. benzyl chloride

Q29. Which of the following is picric acid?

- A. 
- B. 
- C. 
- D. 

Q30. Which does not have a carboxyl group?

- A. benzoic acid B. ethanoic acid
C. Picric acid D. methanoic acid

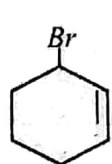
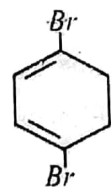

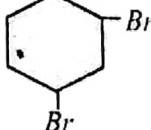
Q31. Such reactions in which hydrogen atom of benzene ring is replaced by an electrophilic group are called:

- A. elimination reactions
B. electrophilic substitution reactions
C. nucleophilic substitution reaction
D. none of these

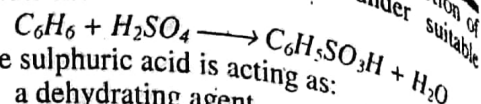
Q32. Which of the following is not an aromatic hydrocarbon:

- A. benzene B. toluene
C. pyridine D. cyclohexane

Q33. What is the product when molecular bromine reacts with cyclohexene at room temperature?

- A. 
- B. 
- C. 
- D. 

Q34. The equation below represents the reaction of benzene with sulphuric acid under suitable conditions.



The sulphuric acid is acting as:

- A. a dehydrating agent
B. an electrophilic reagent
C. a nucleophilic agent
D. an oxidizing agent

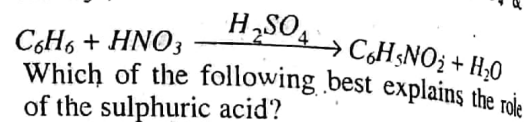
Q35. Which one of the following can be used to carry out the oxidation of methyl benzene to benzoic acid?

- A. chlorine
B. a mixture of conc. nitric and sulphuric acid
C. alkaline potassium manganate (VII) solution
D. None of the above

Q36. The extraordinary stability of benzene ring is attributed to:

- A. three double bonds B. ring structure
C. delocalization of π electrons
D. Presence of sigma bonds

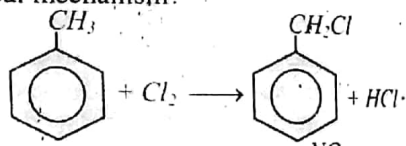
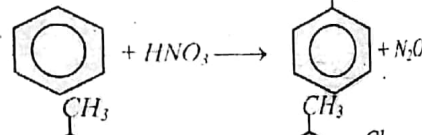
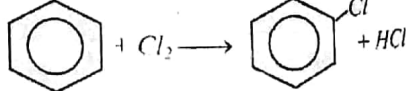
Q37. Nitrobenzene may be prepared by reacting benzene with a mixture of conc. H_2SO_4 & HNO_3 .



Which of the following best explains the role of the sulphuric acid?

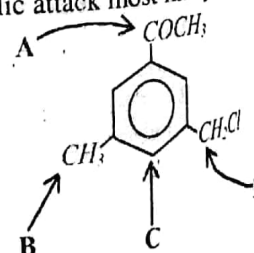
- A. acting as a solvent
B. Protonating nitric acid
C. removing the water produced
D. forming an unstable complex with benzene

Q38. Which one of the following represents a substitution reaction which proceeds by a free radical mechanism?

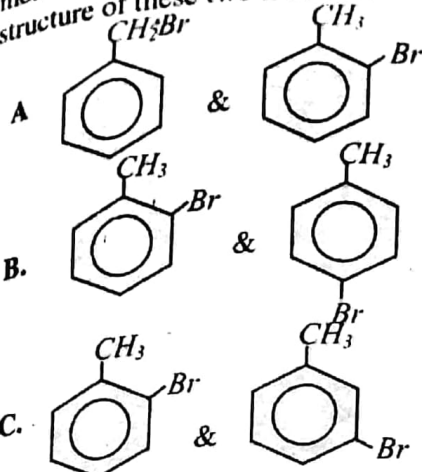
- A. 
- B. 
- C. 
- D. all of the above

Q39. At which of the carbon atoms in the molecule below is electrophilic attack most likely?

- A. A B. B
C. C D. D



40. When methyl benzene is treated with bromine in the presence of a catalyst, a mixture of two monobromo isomers is formed. What are the structure of these two isomers?

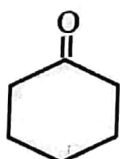


D. all are correct

Q41. In the reaction represented by the equation: $C_6H_6 + Cl_2 \longrightarrow C_6H_5Cl + HCl$. What type of reaction has benzene undergone?

- A. electrophilic addition
B. electrophilic substitution
C. nucleophilic addition
D. nucleophilic substitution

Q42. Which of the following statements about the compound with the following structural formula is correct?



- A. It is an aromatic compound
B. It is an ether
C. It is saturated
D. none of the above

Q43. When benzene is nitrated, conc. HNO_3 & H_2SO_4 react to form an intermediate which attacks the benzene ring. Which one of the following represents this intermediate?

- A. NO^+
B. NO_2^+
C. NO_2^-
D. NO_3^-

Q44. The attacking species in aromatic substitution reactions is:

- A. a nucleophile
B. an electrophile
C. a free radical
D. none of these

Q45. Which is not a meta directing group?

- A. $-NO_2$
B. $-COOH$
C. $-NH_2$
D. $-COR$

Q46. Which of the following is not correct for the preparation of benzene:

- A. by the dry distillation of sodium benzoate with soda lime
B. by the reduction of phenols with Zn dust
C. by the catalytic polymerization of acetylene
D. by the hydrolysis of grignard's reagent

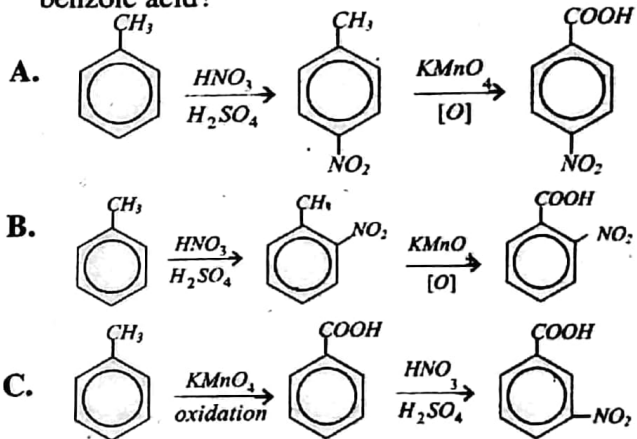
Q47. Although benzene contains three double bonds, it does not give addition reactions readily at ordinary conditions because:

- A. double bond in benzene are strong
B. double bond change their position rapidly
C. resonance lowers the energy of benzene molecules & leads to greater stability
D. all of the above

Q48. The conversion of n-hexane into benzene by passing it over platinum catalyst at $500^\circ C$ under pressure is called:

- A. isomerism
B. Polymorphism
C. Polymerization
D. re arrangement

Q49. How will you convert toluene into p-nitro benzoic acid?



D. None of the above

Q50. A correct IUPAC name for



- A. 4-methyl phenol
B. 1-methyl phenol
C. 1-methyl-4-phenol
D. 1-hydroxytoluene

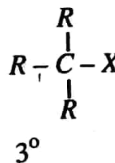
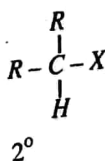
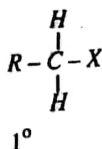
Topic 25

Organic Compounds Based On Functional Groups

ALKYL HALIDES

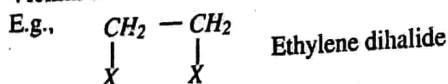
- Alkyl halides are the halogen derivatives of hydrocarbon, obtained by the replacement of one or more hydrogen atoms of hydrocarbon with the halogen atom.
- ⊙ **Monohalogen Derivatives:** These are obtained by the replacement of one hydrogen with one halogen atom.

◇ It may be 1°, 2° and 3° depending on the nature of carbon atom.

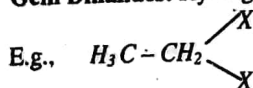


Dihalogen Derivatives: These are obtained by the replacement of two hydrogen atoms with halogen atoms.

Vicinal Dihalides: Halogen atoms are present on the adjacent carbon atoms.



Gem Dihalides: Halogen atoms are present on the same carbon atoms.

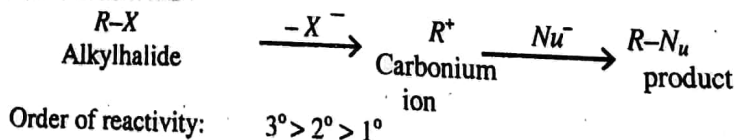


- ⊙ **Physical Properties of Alkyl Halides:** Molecular weight increases, the melting point and boiling point of alkyl halides increase. It increases due to an increase in Vander Waal's forces of attraction.

- ◇ Order of b.p of alkyl halides: Iodide > Bromide > Chloride.
- ◇ Volatility order of alkyl halides: Chloride > Bromide > Iodide.
- ◇ Order of b.p in isomeric form = 1° > 2° > 3°.
- ◇ Solubility: Insoluble in polar solvent, because it is unable to form a hydrogen bond.
- ◇ Density order: Iodide > Bromide > Chloride > Fluoride.
- ◇ **Chemical Properties of Alkyl Halides:** Due to large electro negativity difference between carbon and halogen atom, alkyl halides undergo the following types of reactions.

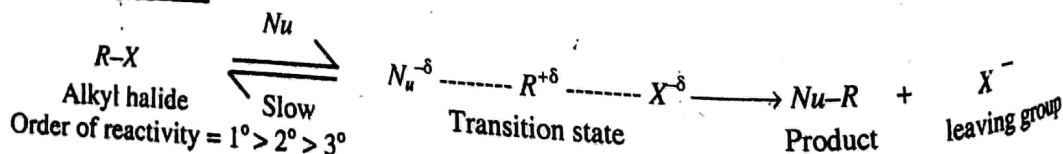
Nucleophilic Substitution Reactions:

S_N1 REACTION



Order of reactivity: 3° > 2° > 1°

S_N2 REACTIONS



⊙	Mechanism
⊙	Kinetics
⊙	Reagent nucleophilicity
⊙	Structure of carbon atom
⊙	Solvent effect
⊙	Stereo chemistry
⊙	Reaction conditions
⊙	Elimination
⊙	The order of

- ◇ RC
- ◇ Alk
- ◇ Del
- ◇ C_n
- ⊙ **Wurtz Fittig** Reaction is obtained. 2R
- ⊙ **Formation of Grignard** halide (grignard reagent) RX

ALCOHOL

Alcohols are

CLASSIFICATION

- ⊙ Monohydric
- ⊙ Dihydric
- ⊙ Polyhydric

CLASSIFICATION

Monohydric group is attached to

- ⊙ Physical Properties

- ◇ Up
- ◇ Al
- ◇ L
- ◇ B
- ◇ is

Chemical

- ◇ R
- ◇ R
- ◇ R

Absolute

Power Al

internal c

Methylat

methylate

Proof Sp

called pro

Chemistry

Elimination Reaction: Generally, 3° alkyl halides undergo an elimination reaction. The order of elimination reaction is 3° > 2° > 1°.

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{X} \xrightarrow{300^\circ\text{C}} \text{RCH}=\text{CH}_2 + \text{HX}$$

♦. RCH_2CH_2X
Alkyl halide

$$C_n H_{2n+1} X + \text{Alcoholic KOH} \longrightarrow C_n H_{2n} + KX + H_2O$$

Ak[yl] halide Alkene

$$2RX + 2Na \longrightarrow RR + 2NaX$$
$$RX + Mg \longrightarrow RMgX$$

ALCOHOL
Alcohols are the compounds containing a hydroxyl group ($-OH$) attached to an alkyl group.

Monohydric Alcohol: Alcohol containing one $-OH$ group.

Dihydric Alcohol: Alcohol containing two $-OH$ groups.

Polyhydric Alcohol: Alcohol containing more than two $-OH$ groups.

Monohydric Alcohol are classified as primary (1°), secondary (2°) & tertiary (3°) on whether the $-OH$ is attached to primary secondary or tertiary carbon

Physical Properties of Alcohol:

- ♦ Upto C_{11} \longrightarrow colourless mobile liquid.
- ♦ Above C_{11} - wax like solid.
- ♦ Lower alcohols are soluble in water but solubility decrease by increasing molecular weight.
- ♦ Boiling point of alcohol increases with increase in carbon atoms. Trend of boiling point in isomeric alcohol is $1^\circ > 2^\circ > 3^\circ$.

Chemical Properties: Following reactions take place in alcohol.

- ♦ Reactions due to breaking of $O - H$ bond.
- ♦ Reactions due to breaking of $C - OH$ bond.
- ♦ Reactions due to both alkyl and $-OH$ group.

Absolute Alcohol: Alcohol containing zero percent of water is called absolute alcohol.

Power Alcohol The mixture of absolute alcohol (25%) with petrol (75%) is used to generate power in internal combustion engines in place of petrol is known as power alcohol.

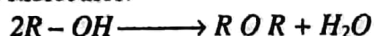
Methylated Spirit: Mixture of 5 to 10% methyl alcohol, 0.5% pyridine and rest alcohol is called methylated spirit.

Proof Spirit: An Alcohol water mixture having 57.1% of ethyl alcohol by volume or 49.3% by weight is called proof spirit.

- ⊕. **Rectified Spirit:** A mixture of 9.56% ethyl alcohol & 4.4% water is called rectified spirit.
- ⊕. **Grain Alcohol:** Ethyl alcohol is called grain alcohol.
- ⊕. **Wood Alcohol:** Methyl alcohol is called wood alcohol.
- ⊕. **Solid Alcohol:** A mixture of ethyl alcohol with calcium acetate and a little amount of stearic acid and convert alcohol into solid state. Such type of alcohol is called solid alcohol.
- ⊕. **Surgical Spirit:** A mixture of 95% rectified spirit and 5% methyl alcohol is known as surgical spirit.
- ⊕. **Mineralized Spirit:** A mixture of 90% rectified spirit, 9% methyl alcohol and a little Pyridine is called mineralized spirit.

ETHER

- ⊕. The compounds containing two alkyl groups bonded with oxygen are called ether ($R-O-R'$).
- ⊕. Ethers that contain two identical alkyl groups ($R-O-R$) are called symmetrical ethers.
- ⊕. Ethers that contain two different groups ($R-O-R'$) are called unsymmetrical ethers.
- ⊕. Ether is anhydride of alcohol because it may be obtained by elimination of water molecule from two alcohol molecules.



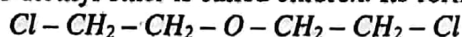
⊕. Physical Properties of Ether:

- ◇. Dimethyl ether and ethyl methyl ether are gases. All other ethers are colourless liquid with a pleasant odour.
- ◇. They are less soluble in water but more soluble in organic solvent. They are themselves good solvent due to the hydrogen bond possibility.
- ◇. Lower ethers are highly volatile and act as anaesthetics.
- ◇. The boiling point of ether is slightly higher than hydrocarbon.

⊕. Chemical Reactions of Ether: Ether undergoes chemical reaction due to the presence of alkyl group, lone pair of electrons on oxygen and breaking of carbon oxygen bond.

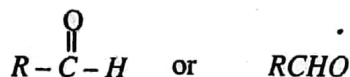
- ⊕. **Natalite:** A mixture of alcohol and ether is called natalite. It is used as a substitute for petrol.

- ⊕. **Chlorex:** β, β' -dichloro diethyl ether is called chlorex. Its formula is:

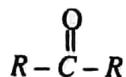


ALDEHYDES & KETONES

- ⊕. Aldehyde and ketone contain the carbonyl group, which consists of carbon-oxygen double bond ($>C=O$).
- ⊕. Aldehydes are the compounds having two hydrogen bonded to a carbonyl group or one alkyl group and one hydrogen bonded to alkyl group. They are represented as:



- ⊕. Ketones are the compounds having two alkyl groups bonded to a carbonyl group. They are represented as:



The carbonyl group is composed of a δ (sigma) bond and π (pi) bond. It is polar due to oxygen's greater electronegativity.

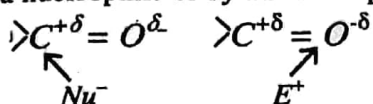
Aldehydes and ketones are collectively known as carbonyl compounds.

Physical Properties of Carbonyl Compounds:

- ◇. First member of aldehyde is gas.
- ◇. From C_2 to C_{10} \longrightarrow are colourless volatile liquid at room temperature.
- ◇. From C_{11} and above \longrightarrow they are solid.
- ◇. Upto C_{12} , ketones are colourless volatile liquid.
- ◇. Above C_{12} , ketones are solid.
- ◇. Lower members of aldehyde have unpleasant odour., but higher members have a fruity odour.
- ◇. Ketones have a pleasant odour.
- ◇. Upto C_6 \longrightarrow aldehydes and ketones are soluble in water.
- ◇. The boiling point of aldehydes and ketones are higher than those of non polar substances of comparable molecular weight due to its polar nature.

Chemistry

Chemical Reactions: The carbonyl group is polarized due to electronegative oxygen atom. Hence, it may be attached either by a nucleophile or by an electrophile.



Nucleophilic addition reaction of carbonyl compounds is catalysed by acids.

Aldol Condensation: Aldehydes or Ketones containing atleast one α hydrogen condense in the presence of dilute alkali to form aldehydic alcohol or ketonic alcohol.

Cannizzaro Reaction: Aldehydes which lack an α -hydrogen, when heated with concentrated solution of $NaOH$, undergo an intermolecular oxidation-reduction reaction. One molecule of such an aldehyde is reduced to an alcohol and other is oxidized to an acid. Ketones do not give this reaction.

CARBOXYLIC ACID

The organic compounds having $-COOH$ group are called carboxylic acid.

Carboxylic acid contains carboxyl group and hydroxyl group.

These are represented by $R-\overset{\overset{O}{\parallel}}{C}-OH$

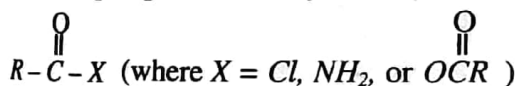
Physical Properties:

- ✧ In both liquid or vapour state, simple carboxylic acid exists as dimer due to intermolecular hydrogen bonding.
- ✧ Carboxylic acid contains both polar $-CO-$ and $-OH$ groups. Due to this it is able to form hydrogen bond. Hence, its boiling point is higher than that of alcohol, aldehyde or Ketones.
- ✧ Due to formation of hydrogen bonding, carboxylic acid is soluble in water and alcohol.
- ✧ Carboxylic acids containing carbon atoms above C_{10} are insoluble in water.
- ✧ Carboxylic acid upto C_{10} are colourless liquid, above C_{10} are waxy solid.

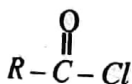
Chemical Reactions: Due to the cleavage of acyl oxygen bond and oxygen hydrogen bond, Carboxylic acid undergoes the reactions which are due to:

- ✧ Replaceable hydrogen
- ✧ Hydroxyl group
- ✧ Carboxylic acid as a whole
- ✧ Alkyl group
- ✧ Carbonyl group

Carboxylic Acid Derivatives: Carboxylic acid derivatives can be regarded as compounds in which the $-OH$ group of a carboxylic acid has been replaced by another atom or group: General formula is

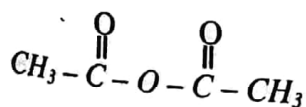
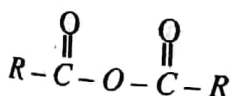


Acid Chlorides: (Acyl Chlorides) have the structure.



E.g. CH_3COCl Acetyl chloride

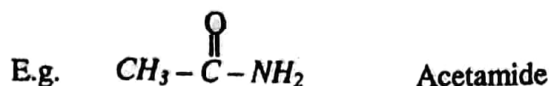
Acid Anhydride: These have the structure.



Acetic anhydride

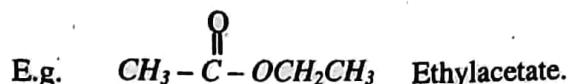
AMIDES

⊙. These have the structure. $R - \overset{\overset{\text{O}}{\parallel}}{\text{C}} - \text{NH}_2$



ESTER

⊙. These have the structure. $R - \overset{\overset{\text{O}}{\parallel}}{\text{C}} - \text{OR}$



AMINE

- ⊙. Amines are the derivatives of ammonia, obtained by the replacement of one or more hydrogen atom by the alkyl group.
- ⊙. Amines are 1°, 2° and 3° depending upon the number of hydrogen atoms replaced by the alkyl group.
- ⊙. **Physical Properties:**
- ◇. Lower amines are gases. From C_3 to C_{11} are volatile liquid and C_{12} and above are solid
 - ◇. Methyl amines and ethylamine have ammonical smell. Higher amines have fishy smell.
 - ◇. Lower amines are soluble in water. In higher amines, solubility decreases.
 - ◇. Amines are base due to the presence of lone pair of electrons on nitrogen atom. The basicity order of amines is $2^\circ > 1^\circ > 3^\circ$. This trend develops due to steric factor.

EXERCISE

- Q01. The general formula for a carboxylic acid is:
A. $\text{C}_n \text{H}_{2n} \text{COOH}$ B. $\text{C}_n \text{H}_{n+1} \text{COOH}$
C. $\text{C}_n \text{H}_{2n+1} \text{COOH}$ D. $\text{C}_n \text{H}_{2n+2} \text{COOH}$
- Q02. Ethanol can be converted into ethanoic acid by the process:
A. Dehydration B. Neutralization
C. Oxidation D. Reduction
- Q03. Dehydration of alcohol is an example of:
A. Substitution reaction
B. Elimination reaction
C. Addition reaction D. Rearrangement
- Q04. If $-\text{OH}$ group is linked to a primary carbon atom, such an alcohol is classified as:
A. 1° alcohol or primary alcohol
B. 2° or secondary alcohol
C. 3° or tertiary alcohol
D. None of the above
- Q05. Which of the following alcohol is called wood spirit:
A. Methyl alcohol B. Ethyl alcohol
C. Propyl alcohol D. Butyl alcohol
- Q06. A positively charged ion in which an oxygen atom is bounded to three other atoms or groups of atoms is called:
A. Carbonium ion B. Carbanion
C. Oxonium ion D. Benzonium ion
- Q07. Which product is formed when ethyl alcohol is treated with acetic acid in the presence of conc. H_2SO_4 ?
A. $\text{CH}_3 - \text{O} - \text{CH}_3$ B. $\text{CH}_3 - \text{CO} - \text{CH}_3$
C. $\text{CH}_3 - \text{COOC}_2\text{H}_5$ D. $\text{CH}_3 \text{COOH}$
- Q08. Alcohols react with $\text{H} - \text{X}$ in the presence of ZnCl_2 as catalyst to give:
A. Aldehydes B. Alkyl halide
C. Aldols D. Ketones
- Q09. Chemical name of Grignard's reagent is:
A. Alkyl sodium halide
B. Alkyl potassium halide
C. Alkyl magnesium halide
D. None of the above
- Q10. Which of the following is the strongest acid?
A. CH_3COOH B. ClCH_2COOH
C. FCH_2COOH D. $\text{CH}_3\text{CH}_2\text{COOH}$
- Q11. The most stable carbonium ion is:
A. Methyl carbonium ion
B. Primary ion
C. Secondary carbonium ion
D. Tertiary carbonium ion
- Q12. Ketones are produced by the oxidation of:
A. Primary alcohol B. Secondary alcohol
C. Tertiary alcohol D. None of the above

- Q13. The elimination of hydrogen and halogen atoms from two adjacent carbon atoms in an alkyl halide is called:
 A. Hydrogenation
 B. Dehydrohalogenation
 C. Hydrohalogenation
 D. Dehalogenation
- Q14. Which of the following compounds is a tertiary alkyl halide:
 A. CH_3Cl
 B. CHCl_3
 C. $(\text{CH}_3)_3\text{CCl}$
 D. $(\text{CH}_3)_2\text{CHCl}$
- Q15. Identify 'A' & 'B' in the following reaction sequence:

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} \xrightarrow{\text{KOH}} \text{A} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{B}$$
 Alcoholic
 A. A = Propene
 B = Isopropyl alcohol
 B. A = Isopropyl bromide
 B = Propylene
 C. A = Isopropyl alcohol
 D. None of these
 B = Acetylene
- Q16. Acid-Catalyzed esterification of carboxylic acid produces which of the following as its final product?

$$\begin{array}{c} \text{O} \\ \parallel \\ \text{R} - \text{C} - \text{OH} \end{array}$$

 A. $\text{R} - \text{C} - \text{OR}$
 B. $\text{R} - \text{COOH}$
 C. RCOBr
 D. HCOOH
- Q17. Which of the following functional groups is not ortho, para directing and activating?
 A. R
 B. OH
 C. NH_2
 D. COR
- Q18. Aldehydes may be distinguished from Ketones by the use of:
 A. Grignard reagent
 B. Tollen's reagent
 C. Concentrated H_2SO_4
 D. Cannizzaro reaction
- Q19. $\text{CH}_3\text{I} \xrightarrow{\text{Mg}} \text{A} \xrightarrow{\text{CO}_2} \text{B} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{C}$
 In the reaction, identify final product 'C':
 A. Formic acid
 B. Acetaldehyde
 C. Acetic acid
 D. Acetone
- Q20. Ethyl alcohol reacts with an excess of conc. H_2SO_4 to form:
 A. Ethylene
 B. Diethyl ether
 C. Ethyl chloride
 D. None of these
- Q21. Which of the following will give positive Tollen's test?
 A. Acetaldehyde
 B. Acetone
 C. Diethyl ether
 D. Acetic acid
- Q22. Which of the following compounds is most basic?
 A. NH_3
 B. $(\text{CH}_3)_3\text{N}$
 C. CH_3NH_2
 D. $(\text{CH}_3)_2\text{NH}$

- Q23. Which of the following compounds is expected to exhibit the highest boiling point?
 A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 B. $\text{CH}_3\text{COOCH}_3$
 C. $\text{CH}_3\text{CH}_2\text{CHO}$
 D. $\text{CH}_3\text{CH}_2\text{CH}_3$
- Q24. A grignard reagent reacts with carbondioxide to give an addition product which on hydrolysis forms:
 A. Ketone
 B. Carboxylic acid
 C. Primary alcohol
 D. Secondary alcohol
- Q25. $\text{CH}_3 - \text{CH}_2 - \text{Br} \xrightarrow[\text{ether}]{\text{Mg}} \text{X} \xrightarrow{\text{H}_2\text{O}} \text{Y}$
 Compound 'Y' in the reaction is an:
 A. Alkane
 B. Alkyl halide
 C. Alkene
 D. Alcohol
- Q26. Which is the acid found in vinegar?
 A. Formic acid
 B. Nitric acid
 C. Acetic acid
 D. Sulphuric acid
- Q27. IUPAC name of the compound, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ is:
 A. Propanoic acid
 B. Palmitic acid
 C. Stearic acid
 D. Butanoic acid
- Q28. What happens when formic acid is treated with ammonical silver nitrate solution:
 A. Acetic anhydride is formed
 B. Silver mirror is formed
 C. Methane is formed
 D. Ammonium acetate is formed
- Q29. Acetyl chloride reacts with sodium acetate to form:
 A. Acetic anhydride
 B. Acetic acid
 C. Ethylacetate
 D. Acetaldehyde
- Q30. Which of the following will exhibit hydrogen bonding:
 A. Ethers
 B. Alkyl halides
 C. Alcohols
 D. Esters
- Q31. Which of the following free radicals is most stable?
 A. CH_3^\bullet
 B. $(\text{CH}_3)_2\text{CH}^\bullet$
 C. $(\text{CH}_3)_3\text{C}^\bullet$
 D. $\text{C}_2\text{H}_5^\bullet$
- Q32. What happens when ethyl alcohol is treated with sodium metal:
 A. Diethyl ether is formed
 B. Sodium ethoxide is formed
 C. An ethene is formed
 D. Aldehyde is formed
- Q33. The IUPAC name of Alcohol is:
 A. Alkanal
 B. Alkanol
 C. Alkanone
 D. Alkene
- Q34. Dry distillation of calcium acetate can form:
 A. Formaldehyde
 B. Acetaldehyde
 C. Acetone
 D. Acetic acid
- Q35. Which of the following compound undergoes cannizzaro's reaction:
 A. HCHO
 B. CH_3CHO
 C. $\text{CH}_3 - \text{CH}_2 - \text{CHO}$
 D. All of these

- Q36. Which of the following does not have a carboxylic group:
 A. Benzoic acid B. Acetone
 C. Acetic acid D. Methanoic acid
- Q37. Which of the following is an example of elimination reaction?
 A. Dehydration of ethanol
 B. Dehydrohalogenation of alkyl halide
 C. Both of them D. None of these
- Q38. The compound which reacts with HBr obeying Markownikoff's rule is:
 A. $CH_2=CH_2$ B. $CH_3-\underset{\text{H}}{\underset{\text{H}}{\text{C}}}=\underset{\text{H}}{\text{C}}-CH_3$
 C. $CH_3-\underset{\text{H}}{\text{C}}=\underset{\text{CH}_3}{\text{C}}-H$ D. $CH_3-\underset{\text{CH}_3}{\text{C}}=\underset{\text{H}}{\text{C}}-H$
- Q39. A Grignard reagent may be prepared by reacting Mg metal with:
 A. methyl amine B. Ethyl amine
 C. Ethyl iodide D. Ethyl alcohol
- Q40. Compounds derived from alkanes by the replacement of hydrogen atom by halogen atom are known as:
 A. Alkyl halide B. Alcohol
 C. Dihalo-alkanes D. Halo-alkenes
- Q41. Addition of halogen acid in unsymmetrical alkene is governed by:
 A. Hund's rule
 B. Markownikoff's rule
 C. Anti-markownikoff's rule
 D. No rule is obeyed
- Q42. Those reagents or groups which have excessive electrons are called:
 A. Nucleophile B. Electrophile
 C. Substrate D. Lewis acid
- Q43. Williamson's synthesis is used to prepare:
 A. Acetone B. Ether
 C. Ethyl acetate D. Bakelite
- Q44. The formation of cyanohydrin from a methanol is an example of:
 A. Electrophilic addition
 B. Electrophilic substitution
 C. Nucleophilic addition
 D. Nucleophilic substitution
- Q45. Ketones are less reactive than aldehydes, because:
 A. $>CO$ group is less polar in ketones
 B. of electromeric effect
 C. Steric hindrance to the attacking reagent
 D. Zeeman effect
- Q46. Acetaldehyde reacts with CH_3MgBr & the product on hydrolysis gives:
 A. Acetone B. n -Propyl alcohol
- Q47. Ethylene glycol, when heated with anhydrous $ZnCl_2$, forms:
 A. Vinyl alcohol B. Ethyl alcohol
 C. Acetic acid D. Acetaldehyde
- Q48. An example of a compound with functional group $-O-R$ is:
 A. Acetic acid B. Diethyl ether
 C. Methyl alcohol D. Acetone
- Q49. Alkyl halide reacts with aqueous KOH to form:
 A. Potassium alkoxide B. Alkene
 C. Alcohol D. Aldehyde
- Q50. The reaction, $CH_3-CH_2Cl + OH^- \rightarrow CH_3-CH_2OH + Cl^-$ is an example of:
 A. Dehydration B. β -elimination
 C. Hydrolysis D. Hydrohalogenation
- Q51. When ethanol is treated with acidified $K_2Cr_2O_7$, it forms acetaldehyde. It is an example of:
 A. Hydrolysis B. Rearrangement
 C. Reduction D. Oxidation
- Q52. Glacial acetic acid is:
 A. 99-100% acetic acid B. 20% acetic acid
 C. 50% acetic acid D. 1% acetic acid
- Q53. The reverse of esterification process is called:
 A. Neutralisation B. Hydrolysis
 C. Polymerization D. None of the above
- Q54. Elimination reaction of primary alkyl halide is:
 A. Single step reaction B. Two step reaction
 C. photochemical reaction
 D. Three steps reaction
- Q55. Boiling point of alcohol is more than that of ether of corresponding molecular weight, because:
 A. Alcohol being more soluble in water
 B. Ethers are non-polar molecules
 C. Hydrogen bonding exists between alcohol molecules
 D. None of these
- Q56. Ethyl alcohol on heating with HI yield:
 A. Ethane B. Ethylene
 C. Methane D. Ethyl iodide
- Q57. Which of the following compounds does not contain an $-OH$ group?
 A. Alcohol B. Aldehyde
 C. Phenol D. Carboxylic acid
- Q58. Which of the following is a gas at room temperature?
 A. CH_3CHO B. $HCHO$
 C. CH_3COCH_3 D. $C_2H_5OC_2H_5$
- Q59. The boiling point of carboxylic acid is higher than expected because of:
 A. Polar character B. Solubility is water
 C. Co-ordinate linkage D. Hydrogen bonding
- Q60. General formula for carboxylic acid is:
 A. $C_nH_nO_2$ B. $C_nH_{2n}O$
 C. $C_nH_{2n}O_2$ D. $C_nH_{2n} + 2O$

Topic 26

Chemistry Of Life

- ② Biochemistry is the chemistry of living matter
- ② It is a branch of chemistry which deals with the study of chemical and physical processes by means of which chemical compounds such as vitamins, lipids, carbohydrates, proteins & nucleic acids are transformed into one another by the cell itself in order to maintain its organized structure and activities.

CARBOHYDRATE

- ② Carbohydrates are defined as polyhydroxyaldehydes or polyhydroxyketones or the substance, which yield such compounds on hydrolysis.

Classification (Based on Taste):

- ② **Sugars:** These carbohydrates are sweet, crystalline and water soluble e.g. glucose, fructose, sucrose.
- ② **Non-Sugars:** These are tasteless, amorphous and insoluble in water. e.g. starch, cellulose.

Sugars can further be Classified as:

- ② **Reducing Sugars:** These sugars reduce Tollen's reagent and Fehling's solution as they contain free aldehydic or Ketonic group along with $-OH$ group on the carbon adjacent to these groups.
 - ✦ E.g. all monosaccharide and all oligosaccharides except sucrose.

- ② **Non Reducing Sugars:** These sugars do not reduce Tollen's reagent or Fehling's solution as they do not contain free aldehydic or Ketonic group with adjacent $-OH$ group
 - ✦ E.g. Sucrose and all polysaccharides.

Classification Based on Molecular Structure:

- ② **Monosaccharides:** These can not be decomposed by hydrolysis to give simpler carbohydrates.

✦ E.g. glucose, fructose.

- ② **Oligosaccharides:** These yield a definite number (usually from 2 to 10) of monosaccharide units on hydrolysis.

✦ E.g. sucrose and maltose (disaccharide), raffinose (trisaccharide).

- ② **Polysaccharides:** These are the high molecular weight carbohydrates which yield many monosaccharide units on hydrolysis.

✦ E.g. starch

- ② **D & L Designations:** The prefixes D and L are used to designate the configuration of the highest numbered asymmetric carbon atom in monosaccharide. If hydroxyl group on this carbon project to the right, we designate it D. If the hydroxyl group on this asymmetric carbon projects to the left, it is designated as L.

- ② **(+) & (-) Sign:** The prefix sign (+) is used to designate a dextrorotatory carbohydrate i.e. the compound which rotate the plane of polarized light to the right.

✦ The prefix sign (-) is used to designate a laevorotatory carbohydrate. i.e. the compound which rotates the plane of polarized light to the left.

- ② **Anomers:** The isomeric structure of glucose i.e. α -D-glucose and β -D-glucose differ in the configuration only around C_1 carbon atom are known as anomeric carbon atom. This is the carbon that becomes chiral in the cyclization reaction.

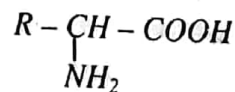
- ② **Mutarotation:** The specific rotation of freshly prepared aqueous solution of α -D-glucose decreases gradually on standing from $+110^\circ$ to $+52.56^\circ$. While that of β -form increases from $+19.7^\circ$ to $+52.56^\circ$. This change in specific rotation of either α or β -form of glucose until a constant value is obtained is called mutarotation and is shown by all reducing sugars, except some ketoses.

The phenomenon of mutarotation is due to slow interconversion of α -form and β -form via an open chain aldehydic form finally forming an equilibrium mixture of two showing constant specific rotation of $+52.56^\circ$.

- ② **Invert Sugar:** It is a mixture of D-glucose and D-fructose. It is obtained by the acidic or enzymatic hydrolysis of sucrose.

AMINO ACID

- ② Amino acids are the hydrolysis product of proteins having both an amino group and carboxylic group. Amino acids are represented by general formula.



- ② According to the position of $-NH_2$ group, these are called α , β , γ amino acids.

CLASSIFICATION

- ② The carboxylic acids which contain a potential (or second) carboxylic group are called acidic amino acids e.g. aspartic acid.
- ② The carboxylic acids which contains a second basic group ($-NH_2$) are called basic amino acids e.g. lysine, arginine.

- ⊕ Neutral amino acids exhibit amphoteric nature. These contain one basic amino and one acidic- COOH group, e.g. glycine, valine.
- ⊕ The amino acids which can be synthesized in the body are known as dispensable amino acids.
- ⊕ The amino acids which cannot be synthesized in the body and have to be supplied in diet are called indispensable (or essential) amino acids.
- ⊕ **Zwitter Ion:** α -amino acids exist as zwitter ion or dipolar ion in aqueous solution.
- ✧ That α -amino acids exist as zwitter ion is confirmed by their solubility in water, high melting point and dipole moments.

PROTEINS

- ⊕ Proteins are macromolecular polymers composed of amino acids as the basic unit.
- ⊕ **Peptide Linkage:**
- ✧ Proteins contain $-\text{CO}-\text{NH}-$ grouping which is called peptide linkage. Proteins are formed by the combination of amino acid molecules through $-\text{NH}_2$ and COOH groups.
- ✧ Polypeptides contain two or more amino acids held by peptide ($-\text{CO}-\text{NH}-$) linkage-protein is a polypeptide.
- ✧ The smallest protein known is insulin which has 51 amino acids.
- ✧ Some bigger proteins like human haemoglobin contain 574 amino acids.

CLASSIFICATION OF PROTEINS

Based on Solubility:

- ⊕ **Simple Proteins:** These on hydrolysis yield a mixture of α -amino acids.
- ✧ E.g. Albumins, globulins.
- ⊕ **Conjugated Proteins:** These on hydrolysis yield a mixture of α -amino acids along with nucleic acid or phosphoric acid or carbohydrates. These proteins contain a non-protein part called prosthetic group.
- ✧ E.g. nucleoproteins.
- ⊕ **Derived Proteins:** Naturally occurring complex proteins on decomposition yield variety of proteins called derived proteins.

Based on Composition:

- ⊕ **Fibrous Proteins:** In these molecules lie side by side forming fibres or they are held together by strong intermolecular hydrogen bonds.
- ✧ E.g. keratin (in hair, nails)
- ⊕ **Globular Proteins:** In these, molecules are folded forming compact units of nearly spheroidal shapes.
- ✧ E.g. albumin in eggs.

Based on Function:

- ⊕ **Structural Proteins:** ✧ E.g. collagen found in skin and bones.
- ⊕ **Contractile Proteins:** ✧ E.g. myosin and actin isolated from skeletal muscle.

- ⊕ **Blood Proteins:** ✧ albumin, globulins. E.g. fibrinogen.
- ⊕ **Antibodies:** Destroy antigens. gamma globulins. ✧ E.g. Also act as
- ⊕ **Enzymes & Hormones:** ✧ proteins.

LIPIDS

- ⊕ Chemically, lipids are esters of long chain fatty acids and alcohols

CLASSIFICATION

Simple Lipids:

- ⊕ These include (a) oil and fats (b) waxes.
- ⊕ Oil and fats are the ester of glycerol and three fatty acids, hence are triglycerides
- ⊕ Generally oils contains more unsaturated fatty acid and are in liquid state.
- ⊕ Fats contain more saturated fatty acids and are in solid state at room temperature.
- ⊕ Waxes are naturally occurring esters of long chain carboxylic acids with long chain alcohols. They are low melting solids
- ⊕ Bees wax is a mixture of esters of C_{24} to C_{26} fatty acids and C_{28} to C_{30} alcohols.
- ⊕ **Complex lipids:** Phospholipids and glycolipids are complex lipids. Phospholipids contain phosphate ester group. Glycolipids are the carbohydrate derivatives of lipids.
- ⊕ **Steroids:** Steroids containing a fused four ring nucleus are major group of lipids. Steroid is a derived lipid.
- ✧ Some of the common steroids are cholesterol, cholic acid, progesterone.

ENZYMES

- ⊕ Enzymes are the chemical catalysts that are capable of controlling all biochemical reactions in living organisms.
- ⊕ All enzymes are proteinous in nature.
- ⊕ Some enzymes are also capable of combining with non-protein prosthetic groups to form conjugated proteins and several enzymes are active only in the conjugated form.
- ⊕ Protein part of enzyme is then called apoenzyme nad non-protein prosthetic group is called coenzyme.
- ⊕ The complete name of enzyme includes the substrate and the nature of the reaction.
- ⊕ Enzyme action is highly specific.
- ⊕ An enzyme is most reactive at optimum temperature.
- ⊕ Factors that affect enzyme activity include substrate concentration, enzyme concentration, pH, temperature and enzyme inhibitors etc.

Vitamins are the naturally occurring essential dietary organic substances which are required by organism in minute amounts (besides carbohydrates, proteins, oil, fats and mineral salts) to maintain normal health of the body and which have to be supplied in food as they cannot be synthesized by the body.

CLASSIFICATION

Fat-Soluble Vitamins: These include vitamin A, vitamin D, vitamin E, vitamin K. These are usually found associated with lipids in natural foods.

Water-Soluble Vitamins: These include vitamin B and vitamin C. Vitamin B represents a whole series of vitamins and each of the B vitamin has a different physiological activity.

Vitamin B Complex Contains the Following Vitamins:

Thiamine (B₁), Riboflavin (B₂), Niacin (B₃), Pyridoxine (B₆), Lipoic acid, Biotin, Pantothenic acid, Inositol, Folic acid, Cyanocobalamine (B₁₂).

EXERCISE

- Q01. Early discovered carbohydrates could be represented by the general formula:
A. $C_x(H_2O)_y$ B. $C_{x-1}(H_2O)_y$
C. $C_x(H_2O)_{y+1}$ D. $C_{x+1}(H_2O)_{y-1}$
- Q02. Which of the following is not carbohydrate but it has formula of $C_x(H_2O)_y$?
A. Glucose B. Acetic acid
C. Formic acid D. Fructose
- Q03. The substance which on hydrolysis produce polyhydroxy aldehyde or ketone are:
A. Amino acid B. Lipids
C. Carbohydrates D. Esters
- Q04. Which of the following contain free aldehydic or ketonic group along with $-OH$ group on carbon adjacent to these groups?
A. All sugars B. Reducing sugars
C. Non-reducing sugars D. None of the above
- Q05. Which of the following oligosaccharide is reducing sugar:
A. Maltose B. Sucrose
C. Glucose D. Fructose
- Q06. Example of aldohexose is
A. Glucose B. Fructose
C. Sucrose D. Maltose
- Q07. Closed chain structure of glucose in which $-OH$ group on carbon no 1 is on R.H.S is:
A. α -isomer B. β -isomer
C. α & β isomer D. None of these

- Q08. Galactose has the same structure as that of glucose except that configuration is reverse at:
A. Carbon no. 1 B. Carbon no. 2
C. Carbon no. 4 D. Last carbon
- Q09. Which of the following is the condensation product of two glucose units?
A. Sucrose B. Maltose
C. Glucose D. Lactose
- Q10. Naturally occurring glucose is:
A. D-sugar B. L-sugar
C. Non-reducing sugar D. All of these
- Q11. The two isomeric closed chain structures of glucose are interconvertible into another via open chain form. This property is called:
A. Isomerism B. Catenation
C. Mutarotation D. Peptide formation
- Q12. Pyranose structures are the hexagonal forms of:
A. Fructose B. Sucrose
C. Lactose D. Glucose
- Q13. Cotton contains:
A. 50% cellulose B. 50% starch
C. 95% cellulose D. 80% glycogen
- Q14. The amino acids which body cannot synthesize are called:
A. Normal amino acids
B. Essential amino acids
C. Synthetic amino acids D. None of these
- Q15. $R-\underset{NH_2}{CH}-COOH$ is the general formula of:
A. Carboxylic acids B. Amino acids
C. Alkane D. Amines
- Q16. Which of the following is glycosidic linkage
A. $\left(\begin{array}{c} | \\ -C- \\ | \end{array} -O-\begin{array}{c} | \\ -C- \\ | \end{array} \right)$ B. $(-O-C-O-)$
C. $(O=C=O)$ D. $\left(\begin{array}{c} O \\ | \\ -C-O- \end{array} \right)$
- Q17. Glycosidic linkage is the characteristic of:
A. Monosaccharide B. Oligosaccharides
C. Polysaccharides
D. Both oligo & polysaccharides
- Q18. Glycogen is an example of:
A. Monosaccharide B. Oligosaccharide
C. Polysaccharide D. Non-reducing sugars
- Q19. Amino acid molecules condense together through:
A. Covalent bond B. Hydrogen bond
C. Peptide linkage D. Glycosidic linkage
- Q20. Peptide linkage is:
A. $(-CO-NH-)$ B. $(-CO-NH_2-)$
C. $(-C_2O-NH_2)$ D. $(-NH_2-CO)$

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- The main protein of milk is:
 Q21. A. Myosin B. Casein
 C. Vitellin D. Glutelin
- Glycine is an example of:
 Q22. A. α -amino acid B. β -amino acid
 C. γ -amino acid D. Neutral amino acid
- Amino acid are soluble in water due to:
 Q23. A. Presence of $-NH_2$ group
 B. Presence of $-COOH$ group
 C. Zwitterion form
 D. Presence of two functional groups
- In body, enzymes act as protein and hydrolyse it into:
 Q24. A. Carbohydrates B. Fats
 C. Amino acids D. Lipids
- In Conjugated protein, non-proteinous substance is called:
 Q25. A. Peptide B. Zwitterion
 C. Fats D. Prosthetic group
- Example of prosthetic group is:
 Q26. A. Haemoglobin B. Caesin
 C. Hordein D. Oryzenin
- The break down of complex food molecules to simpler one by the action of various enzymes is called:
 Q27. A. Fermentation B. Assimilation
 C. Digestion D. None of these
- Proteins are differentiated from fats or carbohydrates on the basis of relative high concentration of:
 Q28. A. Nitrogen in protein B. Calcium in protein
 C. Carbon in protein D. Potassium in protein
- When proteins are hydrolyzed with dilute acid, a mixture of which compound is obtained?
 Q29. A. α -amino acid B. β -amino acid
 C. γ -amino acid D. Neutral amino acid
- When simple proteins are combined with non-proteinous substance, which protein is formed?
 Q30. A. Simple protein B. Conjugated protein
 C. Derived protein D. Albumin
- Citrus fruits are important source of vitamin:
 Q31. A. B B. C
 C. D D. K
- Which of the following is vitamin B₁:
 Q32. A. Riboflavin B. Tocopherol
 C. Thiamine D. Ascorbic acid
- Deficiency of vitamin D results in:
 Q33. A. Scurvy B. Rickets
 C. Beri-Beri D. Night blindness
- Carbohydrates contain:
 Q34. A. $-CHO$ group B. $\chi = O$
 C. $-OH$ group D. All of the above
- Which of the carbohydrate is used in silvering of mirror:
 Q35. A. Glucose B. Sucrose
 C. Fructose D. Starch
- Which of the following statement is not correct about vitamins:
 Q36. A. Vitamins are called accessory food factors
 B. They have no food value
 C. All vitamins are water soluble
 D. Their deficiency or absence in diet causes a specific disease
- The simple sugars, which cannot be hydrolyzed are called:
 Q37. A. Monosaccharides B. Di-saccharides
 C. Oligosaccharides D. Polysaccharides
- Esters of glycerol and fatty acids are known as:
 Q38. A. Carbohydrates B. Fats or oils
 C. Waxes D. Steroids
- A wax is:
 Q39. A. A solid fat B. A solid hydrocarbon
 C. The ester of a long chain fatty acid and a long chain alcohol
 D. Triglycerides
- Such substances, which catalyze the chemical reaction in living system are called:
 Q40. A. Proteins B. Hormones
 C. Lipids D. Enzymes
- An increase of level of cholesterol in the blood serum of human beings causes:
 Q41. A. Low blood pressure
 B. High blood pressure
 C. Abnormal development
 D. Night blindness
- The process of hydrolysis of oils and fats for the manufacture of soap is called:
 Q42. A. Neutralization B. Saponification
 C. Hardening of oils D. Fermentation
- Which is not a member of vitamin B complex group:
 Q43. A. Retinol B. Thiamine
 C. Riboflavin D. Pyridoxine
- Which of the following yields twice or many calories as per gm of carbohydrates:
 Q44. A. Vitamins B. Fats
 C. Proteins D. Minerals
- Which of the following molecules is capable of forming zwitter-ion?
 Q45. A. NH_2-CH_2-COOH
 B. $CH_3-CH_2-NH_2$
 C. CH_3-CH_2-COOH
 D. All of the above
- Glucose & fructose are:
 Q46. A. Chain isomers B. Geometrical isomers
 C. Functional isomers D. Metamers

Chemistry Of Life

Chemistry

- Which of the metal atom?
 Q47. A. Riboflavin
 C. Vitamin A
- The carbohydrate human system
 Q48. A. Sugar
 C. Cellulose
- Which of the fo
 Q49. A. Pepsin
 C. Diastase
- Biuret test is presence of:
 Q50. A. $-C-O-$
 B. $-NH-C-$
 C. $-O-C-$
- Ascorbic acid
 Q51. A. Protein
 C. Vitamin
- Insulin harmon
 Q52. A. Protein
 C. Fat
- Hydrolysis of
 Q53. A. Hydration
 C. Esterification

Q47. Which of the following vitamins contains a metal atom?
 A. Riboflavin B. Vitamin B_{12}
 C. Vitamin AD. Vitamin B_6

Q48. The carbohydrate that cannot be digested in the human system is:
 A. Sugar B. Lactose
 C. Cellulose D. Maltose

Q49. Which of the following is proteolytic enzyme?
 A. Pepsin B. Insulin
 C. Diastase D. Adenine

Q50. Biuret test is given by proteins due to the presence of:

- A. $(-C-O-C-)$ group
 B. $(-NH-CO)$ group
 C. $(-O-C-O-)$ group D. $-SH$ group

Q51. Ascorbic acid is:
 A. Protein B. Enzyme
 C. Vitamin D. Amino acid

Q52. Insulin hormone chemically is
 A. Protein B. Steroid
 C. Fat D. Carbohydrate

Q53. Hydrolysis of sucrose is called:
 A. Hydration B. Saponification
 C. Esterification D. Inversion

Q54. Sweetest sugar is:
 A. Glucose B. Sucrose
 C. Fructose D. Maltose

Q55. Gastric juice contains:
 A. Nitric acid B. Hydrochloric acid
 C. Sulphuric acid D. Nitrous acid

Q56. Which of the following vitamin is water soluble?
 A. K B. D
 C. B D. A

Q57. Carbohydrates with more than 10 monosaccharide units are called:
 A. Oligosaccharides B. Disaccharides
 C. Polysaccharides D. Trisaccharides

Q58. A biological catalyst is essentially:
 A. An amino acid B. An enzyme
 C. A carboxylic acid D. A protein

Q59. The carbohydrates that reduce Toelen's reagent or Fehling's solution are called:
 A. Non-reducing sugar B. Reducing sugar
 C. Simple sugar D. None of these

Q60. Which of the following is not an essential constituent of carbohydrates:
 A. C B. H
 C. O D. N

Topic 27

Chemical Industries

FERTILIZERS

- ⊕ These are the chemical substances containing N,P,S etc. essential for growth of crops.
 - ⊕ A fertilizer is used to make up the deficiency of the elements taken up by plants, to give an addition supply of food and to maintain pH of soil.
 - ⊕ **Natural Fertilizers:** Natural fertilizers such as plants, animal manure and naturally occurring nitrates have always been used for providing nutrition to plants through soil.
 - ⊕ **Synthetic Fertilizers:** These are nitrates, sulphates of ammonium, sodium and potassium. In addition of these chemicals, phosphates and sulphates are also used as synthetic fertilizers.
- Examples of nitrogen fertilizers are urea and ammonium nitrate and those of phosphorous fertilizers are calcium super phosphate and diammonium phosphate. Potassium chloride, potassium sulphate and potassium nitrate are the examples of potassium fertilizers.

DETERGENTS

- ⊕ The cleaning agent which does not form scum with hard water is called detergent. Synthetic detergents are better cleaning agents than soaps.
- ⊕ Soaps are sodium or potassium salts of long chain fatty acids whereas detergents contain sodium or potassium salts of aryl or alkyl sulphonated acids as one of their constituents.
- ⊕ The main constituents of detergents are:
 - i) Surfactants or surface active agents
 - ii) Builders
 - iii) Additives. They include
 - (a) foam stabilizers (b) anti deposition agent (c) optical brighteners
- ⊕ **Surfactant** is an organic compound that reduces surface tension of water. One end of a surfactant is water-loving and other is dirt-loving.
- ⊕ **Builders** are the polyphosphates of sodium triphosphate and tetra sodium phosphate. These are the water softeners and prevent redeposition of dirt or grease particles from wash water.

GLASS

- ⊕ Physically, glass may be defined as hard, rigid, brittle, under cooled non-crystalline pseudo solid

having no definite melting point and sufficient high viscosity to prevent crystallization.

- ⊕ Chemically, glass may be defined as a fused mixture of silicates, alkali (soda ash) and alkaline earth compounds (limestone) along with other constituents like barium oxide, lead oxide, calcium oxide and tin oxide etc.
- ⊕ Major ingredients of glass are sand, soda ash and limestone while minor ingredients are borax, potash, boric oxide and Zinc oxide etc.

VARIETIES OF GLASS

- ⊕ **Soft Glass:** It is mixture of sodium and calcium silicates. It is used in making common glass wares.
- ⊕ **Hard Glass:** It is a mixture of potassium and calcium silicates.
- ⊕ **Flint Glass:** It is transparent potash lead glass used in making electric bulbs and optical instrument.
- ⊕ **Pyrex Glass:** It is mixture of Zinc and barium borosilicates having poor content of alumina. These are very resistant to sudden variations in temperature and common reagents.
- ⊕ **Annealing:** The process of slow cooling of glass is known as annealing.
- ⊕ **Etching of Glass:** When glass, which is a mixture of Na_2SiO_3 & CaSiO_3 is exposed to the action of HF , it is attacked, with the formation of sodium, calcium and silicon fluoride. This process is used to produce design on glass

PLASTIC

- ⊕ A solid material, which becomes mobile on heating and thus can be cast into moulds, is called plastic.
- ⊕ Plastics are prepared by addition and condensation polymerization processes.
- ⊕ Plastics which become soft and melt on heating and can be moulded or remoulded are known as thermo-softening plastics or simply thermoplastics.
- ⊕ They are formed by addition polymerization.
- ⊕ Examples of thermoplastics are Polyethylenes, Nylon, PVC and Polystyrenes.
- ⊕ Plastics which cannot be softened easily on heating and thus cannot be remoulded are known as thermosetting plastics.
- ⊕ These are formed by condensation polymerization.
- ⊕ Examples of thermosetting plastic are bakelite, amino resins.
- ⊕ The basic materials used for making plastics are:
 - i. **Plasticizer:**
 - ⬥ These are organic chemicals.

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Chemistry

These are added to improve workability, to soften a plastic.

ii. Fillers:

These are added to increase the strength, volume or bulk of plastic, its resistant to fire.

iii. Stabilizers:

These are antioxidants and prevent chemical degradation of plastic.

iv. Reinforcing Agents:

These materials improve the mechanical properties of plastic.

FIBRES

All fibres, natural or synthetic are derived from high polymer compounds.

Natural fibres are obtained from cotton, jute, silk, wool etc.

Cellulose is the main constituent of most natural fibres, semi-synthetic fibres like viscose rayon and acetate fibres are obtained from natural polymeric materials.

True synthetic fibres or polyfibres (e.g. nylon, dacron etc) are produced from polymers which are obtained by addition or condensation polymerization.

Cotton and wool are the natural fibres in the staple form while silk, rayon, nylon and various synthetic fibres have continuous filament form.

A fibre has a cross-section of one denier (denier is the measure of weight per unit length) if 9000 metres of it weigh one gram.

Stretching of fibre is one of the best physical treatment given to the fibre to orient the molecules and set up crystalline lattices, before it can be used as a fibre for practical purposes.

Natural silk contains nitrogen and on burning it shrinks into a ball of cinder, giving a smell of burnt hair.

Artificial silks do not contain nitrogen and on burning it forms a thread of ash.

Rayon or artificial silk derived from cellulose are nitrocellulose, pyroxilin, acetate rayon, viscose rayon.

PAINTS

Paints may be defined as liquid products which hold in suspension solid colouring matters called pigment. Such stable mechanical mixtures of pigments can be applied evenly to a surface for protective purpose.

Various constituents of paints are metal protecting pigments, drying oils, toners, extenders of fillers, thinner, anti skinning agents and plasticizers.

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Distempers are water paints, which consist of pigments compounded with water and adhesives such as Zinc oxide, glue or casein.

Varnishes may be defined as unpigmented colloidal dispersion of natural or synthetic or both resins in oils which provide protective or decorative coatings on the surface. These constituents dry on the surface by evaporation, oxidation and polymerization.

Lacquer or non-convertible coating is a liquid coating containing basic film forming ingredients (cellulose esters or ethers) and plasticizers with or without resins.

Pigments are organic or inorganic substances which are used in surface coatings. These are employed in plastic, paper, rubber, ink and linoleum industries to impart colour.

EXERCISE

Q01. Which of the following is not a use for ammonia:

- A. Ammonia may be used as fertilizer
- B. The production of nitric acid
- C. Ammonia is used as refrigerant
- D. None of the above

Q02. The most commonly and widely used nitrogenous fertilizer in Pakistan is:

- A. Nitrolin
- B. Urea
- C. Ammonium sulphate
- D. Ammonium nitrate

Q03. The phosphatic fertilizer obtained by mixing phosphorite with sulphuric acid in special chamber is called:

- A. Super phosphate
- B. Triple phosphate
- C. Diammonium phosphate
- D. None of the above

Q04. Soft glass is a mixture of:

- A. Sodium & calcium acetate
- B. Sodium & calcium silicate
- C. Zinc & barium silicates
- D. Sodium & zinc chloride

Q05. The process of slow cooling of glass is known as:

- A. Annealing
- B. Etching
- C. Filtration
- D. None of the above

Q06. When glass is exposed to the action of HF, it is attacked, with the formation of sodium, calcium and silicon fluoride is called:

- A. Grinding
- B. Calcination
- C. Etching
- D. Annealing

Q07. Glass is decolourized by:

- A. Cl_2
- B. Bleaching powder
- C. MnO_2
- D. Charcoal

- Q08.** Which is the better cleaning agent:
A. Soap B. Detergent
C. Both of these D. None of the above
- Q09.** The fibres obtained from cotton, Jute, Silk, Wool are called:
A. Artificial fibres B. Synthetic fibres
C. Natural fibres D. Semi-synthetic fibres
- Q10.** Which is naturally occurring polymer:
A. Polyethylene B. PVC
C. Proteins D. Propylene
- Q11.** Which of the following is not a polymer:
A. Rubber B. Cellulose
C. Fructose D. Protein
- Q12.** Bakelite plastic is formed by the combination of:
A. Formaldehyde & phenol
B. Acetaldehyde & phenol
C. Acetone & phenol
D. Benzaldehyde & phenol
- Q13.** Which of the following is thermosetting plastic:
A. Bakelite B. Polyethylene
C. Polystyrene D. Rubber
- Q14.** Widdy used thinner in paints is:
A. Water B. Kerosene oil
C. Linseed oil* D. Turpentine oil
- Q15.** Chemical formula of urea is:
A. $(NH_2)_2CO$ B. $NH-CO-NH$
C. KNO_3 D. NH_4CNS
- Q16.** The surface active agents in detergents are called:
A. Soap B. Pigments
C. Surfactants D. Varnish
- Q17.** A mixture of resin, drying oil and a volatile solvent is known as:
A. Polymerization B. Varnish
C. Surfactants D. Paints
- Q18.** Glass is also known as:
A. Pseudo solid B. Super cooled liquid
C. Both of these D. None of these
- Q19.** Which of the following is polyamide:
A. Polyethylene B. Nylon
C. Protein D. Soap
- Q20.** The lipids which can be further subdivided into simple lipids are:
A. Saponifiable lipids
B. Non-saponifiable lipids
C. Compound lipids D. Steroids
- Q21.** The hydrophilic part of the detergent dissolves in:
A. Organic solvent B. Soap water
C. Water D. All of the above
- Q22.** Coloured glass is manufactured by adding:
A. Borosilicates
B. Transition metal oxides
C. Sodium silicate
D. Lime stone
- Q23.** Which of the following is considered as the man-made fibre:
A. Nylon B. Rubber
C. Rayon D. Plastics
- Q24.** A paint is usually composed of:
A. A binder B. A pigment
C. A volatile solvent D. All of the above
- Q25.** Sodium salt of long chain carboxylic acid is called:
A. Soap B. Detergents
C. Fats D. Steroids
- Q26.** The detergents could be classified into three types, Anionic, Cationic & Non-ionic depending on:
A. long chain of carboxylic acid
B. ionic charge present at the soluble end of their chain
C. non-polar hydrocarbon chain
D. aliphatic long chain alcohol
- Q27.** An unpigmented colloidal dispersion of natural or synthetic or both resins in oils which provide protective or decorative coating on the surface is called:
A. Paints B. Varnishes
C. Dyes D. Pigments
- Q28.** Which is not a natural polymer:
A. Silk B. Wool
C. Leather D. Nylon
- Q29.** Heating rubber which sulphur is known as:
A. Galvinisation B. Vulcanisation
C. Sulphonation D. Bessemerisation
- Q30.** Teflon is a polymer of monomer:
A. Mono fluoroethylene B. Difluoroethane
C. Tetra fluoroethane
D. Tri fluoroethane

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Experimental Techniques In Chemistry

PURIFICATION METHODS FOR ORGANIC COMPOUNDS

Crystallization: Organic compounds can be purified by crystallization from a suitable solvent, which can dissolve or large quantity of the substance at high temperature and deposit the same when cooled. Various solvents such as water, alcohol, acetone, ether, benzene etc. are employed for crystallization.

Fractional Crystallization: If the impure substance is a mixture of two substances, both of which are soluble, the less soluble substance will crystallize out first from a saturated solution. The mother liquor on further concentration will deposit crystals of other substance contaminated with first substance. The process is repeated several times to get pure samples of both the substances.

Sublimation: It is a process in which a solid, when heated vapourizes directly without passing through the liquid phase and these vapours can be condensed to form the solid again and the impurities present are non-volatile. Substances like benzoic acid, naphthalene, camphor, ammonium chloride, dry ice, iodine etc. can be purified by this method.

Filtration: The process of filtration is used to separate insoluble particles from liquids and it can be performed with several types of filter media.

The rate of filtration can be considerably increased using a fluted filter paper.

Solvent Extraction: This technique involves the separation of a solute from a solution by shaking it with an immiscible solvent in which the solute is more soluble. The technique is mostly applied to separate organic compounds from water.

Solvent extraction is an equilibrium process and it is controlled by distribution law. The technique is particularly useful when the compound to be separated is volatile or thermally unstable.

Simple Distillation: Liquids which boil under ordinary pressure without decomposition and are associated with non-volatile impurities are purified by simple distillation. It is a process in which vapourization and condensation are going on side by side.

Fractional Distillation: Fractional distillation is used for the purification of two or more miscible liquids whose boiling points are very close to

each other. The liquid mixture can be separated by fractional distillation if they do not form a constant boiling azeotropic mixture.

④. **Steam Distillation:** Substances having high molecular weight, insoluble in water but volatile in steam are purified by steam distillation.

⑤. **Vacuum Distillation:** Organic compounds which decompose below their boiling point are purified by distillation under reduced pressure. For example, glycerine boils with partial decomposition at 290°C and 760mm pressure. When the pressure is reduced by suction, the liquid boils at a lower temperature and escapes decomposition at 180°C under reduced pressure of 12mm.

⑥. **Chromatography:** Chromatography is the latest technique used for the purification of organic and inorganic substances.

Chromatography is a technique used for separating the components of a mixture. These components are distributed between a stationary and a mobile phase. The stationary phase may be a solid or liquid supported on a solid. It absorbs the mixture under separation. The mobile phase may be a liquid or a gas and while passing over the stationary phase, competes with it for the constituents of the mixture.

In paper chromatography, the stationary phase is water absorbed on paper. The mobile phase is usually an organic liquid.

The techniques of chromatography are very useful in organic synthesis for separation, isolation and purification of the products.

EXERCISE

- Q01. Ion exchange chromatography falls into which of the following categories?
A. Liquid-Solid B. Liquid-Liquid
C. Gas-Solid D. Gas-Liquid
- Q02. Which of the following methods below does not represent a method of separating mixtures:
A. distillation B. chromatography
C. salivation D. fractional crystallization
- Q03. Two solids with different solubilities can be separated by:
A. fractional crystallization
B. sublimation
C. simple crystallization
D. extraction by solvents
- Q04. Two immiscible liquids may be separated from each other by:
A. fractional distillation
B. separating funnel
C. steam distillation D. chromatography
- Q05. Due to the formation of following complex, Prussian blue colour is observed in the detection of nitrogen in Lassaigne's test:
A. $Na_4[Fe(CN)_6]$ B. $Fe_4[Fe(CN)_6]_3$
C. $Na_4[Fe(CN)_5]$ D. $[Fe(CN)_2]$

- Q06. The latest technique used for the purification of organic compounds containing minute quantities is:
 A. distillation B. sublimation
 C. chromatography D. Crystallization
- Q07. Chromatography in which stationary phase is a solid is classified as:
 A. adsorption chromatography
 B. absorption chromatography
 C. partition chromatography
 D. paper chromatography
- Q08. R_f value is related to its distribution coefficient and is given by:
 A. $R_f = \frac{\text{Distance travelled by a component from the original spot}}{\text{Distance travelled by solvent from the original spot}}$
 B. $R_f = \frac{\text{Distance travelled by solvent from the original spot}}{\text{Distance travelled by solution from the original spot}}$
 C. both of them D. none of these
- Q09. The comparative rates at which the solutes move in paper chromatography depends on:
 A. the size of paper used
 B. R_f values of solutes
 C. temperature of the experiment
 D. size of chromatographic tank
- Q10. A mixture of glucose and fructose can be separated by:
 A. fractional distillation B. sublimation
 C. fraction crystallization D. filtration
- Q11. Simple distillation is the process which are used to separate a mixture of two compounds having:
 A. similar solubilities.
 B. non-volatile component.
 C. volatile component.
 D. decomposition at their boiling points.
- Q12. In paper chromatography:
 A. mobile phase is liquid & stationary phase is solid.
 B. mobile phase is solid & stationary phase is liquid.
 C. both phase are solids.
 D. both phases are liquids.
- Q13. Separation of the substances by fractional crystallization depends upon their differences in:
 A. solubility B. densities
 C. crystalline shape D. all of these
- Q14. For a compound to be purified by steam distillation:
 A. impurities must be non-volatile.
 B. liquid must be immiscible with water.
 C. molecular weight of the compound is expected to be high.
 D. all are correct
- Q15. The process of strong "heating of a substance in the absence" of air is called:
 A. destructive distillation
 B. fractional crystallization
 C. vacuum distillation D. sublimation

- Q16. The method used for the separation of iodine and sand is:
 A. vaporization B. chromatography
 C. sublimation D. distillation
- Q17. The method used for the purification of organic compound which decomposes at its boiling point:
 A. solvent extraction B. vacuum distillation
 C. crystallization D. distillation
- Q18. Which one of the following mixtures can be separated into pure components by fractional distillation?
 A. benzene - toluene B. water - ethanol
 C. water - Nitric acid D. water - HCl acid
- Q19. The process in which vapourization and condensation are going on side by side are:
 A. crystallization B. simple distillation
 C. chromatography D. solvent extraction
- Q20. "A solute distributes itself between two immiscible liquids in a constant ratio of concentration irrespective the amount of solute added". It is the statement of:
 A. Distribution law B. Gay-Lussac's law
 C. Chromatography D. None of these
- Q21. The process of filtration is used to separate insoluble particles from liquids. It can be performed by:
 A. filter paper B. gooch crucible
 C. sintered glass crucible D. all of the above
- Q22. The process in which solid when heat vapourizes directly without passing through the liquid phase is termed as:
 A. crystallization B. sublimation
 C. filtration D. vapourization
- Q23. When

$$K = \frac{\text{concentration of a component in the moving phase}}{\text{concentration of that component in the stationary phase}}$$
 K is:
 A. Rate constant B. Equilibrium constant
 C. Distribution coefficient
 D. Gas constant
- Q24. Which one used to measure the masses of atoms and molecules with great accuracy:
 A. Mass spectrometers B. P^H meter
 C. Spectrophotometer D. None of these
- Q25. Which of the following method is used which can measure the concentration of hydrogen ions in solution?
 A. By volumetric titration
 B. By E.M.F of Galvanic cell
 C. By P^H meter
 D. All of the above
- Q26. A convenient way to filter a precipitate is by suction through a:
 A. filter crucibles B. collection the crystals
 C. cooling D. sublimation

- Q01. Which of the following is not correct about the elements in the periodic table?
 A. they are reduced in electronegativity from left to right
 B. the ionic radius increases from left to right
 C. the electronegativity increases from left to right
 D. all of the above
- Q02. Which element has the highest electronegativity?
 A. barium
 C. magnesium
- Q03. Which equation represents the ionization energy of bromine?
 A. $\text{Br(g)} \rightarrow \text{Br}^+(\text{g})$
 B. $\text{Br(g)} \rightarrow \text{Br}^-(\text{g})$
 C. $\frac{1}{2} \text{Br}_2(\text{g}) \rightarrow \text{Br}^+(\text{g})$
 D. $\frac{1}{2} \text{Br}_2(\text{g}) \rightarrow \text{Br}^-(\text{g})$
- Q04. In which reaction does the nitrogen atom act as a Lewis base?
 A. 1 only
 C. 3 only

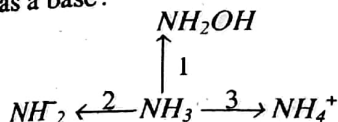
- Q05. The electron configuration of the following elements in order:
 A. $F < Cl < Br$
 C. $I < Br < F$
- Q06. Which is the most electronegative element?
 A. chlorine
 C. nitrogen
- Q07. Which of the following is not a noble gas?
 A. deuterium
 C. protium
- Q08. AgCl is soluble in which of the following?
 A. $[\text{Ag}(\text{NH}_3)_2]^+$
 C. $[\text{Ag}(\text{NH}_3)_4]^+$
- Q09. An element with atomic number 35 has the following electronic configuration:
 A. s-block
 C. representative element
 D. zero group
- Q10. The energy released when an electron is added to a neutral atom is called:
 A. bond energy
 C. electron affinity

INORGANIC CHEMISTRY

MISCELLANEOUS EXERCISE

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- Q11. Which of the following statements are true about the elements in group IIA of the periodic table?
- they are reducing agents
 - the ionic radius increases down the group
 - the electronegativity decreases down the group
 - all of the above
- Q12. Which element is likely to have an electronegativity similar to that of aluminium?
- barium
 - beryllium
 - magnesium
 - boron
- Q13. Which equation relates to the first ionization energy of bromine?
- $Br(g) \rightarrow Br^-(g) + e^-$
 - $Br(g) \rightarrow Br^+(g) + e^-$
 - $\frac{1}{2} Br_2(g) \rightarrow Br^-(g) - e^-$
 - $\frac{1}{2} Br_2(g) \rightarrow Br^+(g) + e^-$
- Q14. In which reaction of ammonia has the nitrogen atom acted as a base?



- 1 only
 - 2 only
 - 3 only
 - 1 & 2 only
- Q15. The electron affinity of halogens increases in the order:
- $F < Cl < Br < I$
 - $Cl < F < Br < I$
 - $I < Br < F < Cl$
 - $I < Br < Cl < F$
- Q16. Which is the most electronegative of all the elements?
- chlorine
 - fluorine
 - nitrogen
 - oxygen
- Q17. Which of the following is radioactive?
- deuterium
 - nascent hydrogen
 - protium
 - tritium
- Q18. AgCl is soluble in ammonia due to the formation of:
- $[Ag(NH_3)_2]^{2+}$
 - $[Ag(NH_3)_2]^+$
 - $[Ag(NH_3)_4]^+$
 - $[Ag(NH_3)_4]^{2+}$
- Q19. An element which has the electronic configuration ns^2np^6 belongs to the:
- s-block
 - d-block
 - representative elements
 - zero group
- Q20. The energy released when an extra electron is added to a neutral gaseous atom is called:
- bond energy
 - electronegativity
 - electron affinity
 - ionization energy

- Q11. NaH is an example of a/an:
- ionic hydride
 - metallic hydride
 - molecular hydride
 - polymeric hydride
- Q12. The elements with atomic numbers 10, 18, 36, 54 and 86 are:
- light metals
 - Inert gases
 - halogens
 - rare earth metal
- Q13. The elements in the periodic table are arranged as:
- increasing atomic number
 - increasing mass
 - increasing volume
 - alphabetically
- Q14. Variable valency is exhibited by:
- non-metals
 - liquids
 - transition elements
 - alkali metals
- Q15. Which is most acidic?
- Na_2O
 - MgO
 - Al_2O_3
 - CrO
- Q16. Which of the following is paramagnetic?
- O_3
 - He
 - O_2^{2-}
 - H_2
- Q17. The metallic character in moving from left to right in the periodic table:
- increases
 - decreases
 - remains constant
 - first decreases then increases
- Q18. An important constituent of amalgam is:
- Al
 - Hg
 - Mg
 - Zn
- Q19. The noble gas forming maximum number of compounds is:
- Ne
 - Xe
 - Kr
 - Rn
- Q20. Permanent hardness of water is due to the presence of:
- calcium bicarbonate
 - sulphates & chlorides of sodium & potassium
 - sulphates & chlorides of calcium & magnesium
 - nitrates of Na & K
- Q21. Which is manufactured by electrolysis of fused NaCl?
- NaOH
 - Na
 - $NaClO_3$
 - all of these
- Q22. When NaOH crystals are left in open air, they acquire a fluid layer around each crystal as:
- they absorb moisture from air
 - they start melting
 - they react with air to form a liquid compound
 - they absorb CO_2 from air
- Q23. Coinage metals show the properties of:
- typical elements
 - normal elements
 - transition elements
 - inert gases

- Q24. Brass contains:
A. $Cu + Sn$ B. $Cu + Ni$
C. $Mg + Al$ D. $Cu + Zn$
- Q25. Which of the following ore is malachite:
A. Cu_2S B. $CuCO_3 \cdot Cu(OH)_2$
C. Cu_2O D. $CuCO_3$
- Q26. Bleaching powder is obtained by the interaction of chlorine and:
A. dry slaked lime B. dry calcium oxide
C. dilute solution of $Ca(OH)_2$
D. conc. solution of $Ca(OH)_2$
- Q27. Which of the following is the weakest base?
A. $NaOH$ B. $Ca(OH)_2$
C. KOH D. $Zn(OH)_2$
- Q28. Which of the following ion is colourless?
A. Cu^+ B. Co^{2+}
C. Ni^{2+} D. Fe^{3+}
- Q29. Which is not a mineral of aluminium:
A. malachite B. bauxite
C. Corundum D. diaspore
- Q30. Glass is soluble in:
A. H_2SO_4 B. $HClO_4$
C. HF D. aqua regia
- Q31. Diamond and graphite are:
A. isomers B. allotropes
C. isotopes D. polymers
- Q32. Water gas is an important industrial fuel. It is a mixture of:
A. $H_2O + air$ B. $CO + H_2$
C. $CO_2 + H_2$ D. $H_2O + CO$
- Q33. In Haber's process of the manufacture of ammonia, the following catalyst is used:
A. Platinised asbestos
B. Iron with molybdenum as promotion
C. copper oxide D. Alumina
- Q34. Which catalyst is used in the contact process for manufacturing H_2SO_4 ?
A. Ni B. V_2O_5
C. Pt D. Fe
- Q35. Mark the halogen, which is solid at room temperature:
A. Chlorine B. Bromine
C. Fluorine D. Iodine
- Q36. Mark the variety of iron, which contains smallest quantity of carbon:
A. Pig iron B. Cast iron
C. Wrought iron D. Steel
- Q37. Which of the following metal shows more than one oxidation state:
A. Al B. Fe
C. Na D. Mg
- Q38. When water is boiled for some time, it becomes free from:
A. both permanent & temporary hardness
B. its heavy water content
C. permanent hardness only
D. temporary hardness only

Inorganic Chemistry (Miscellaneous Ex)

- Q39. Which one of the following alkali metals is the most electropositive?
A. Li B. K
C. Rb D. Cs
- Q40. Alkali metals show typical characteristics of:
A. inner transition elements
B. noble gases
C. representative elements
D. transition elements
- Q41. Which of the following halogens has the highest heat of hydration?
A. fluorine B. bromine
C. Chlorine D. iodine
- Q42. Helium is used in balloons instead of hydrogen because it is:
A. lighter than hydrogen B. incombustible
C. more abundant than hydrogen
D. radioactive and easily detected
- Q43. Some metals occur in the native form because of their:
A. high reactivity B. low reactivity
C. high electronegativity D. low density
- Q44. Which one of the following metal ions is diamagnetic?
A. Cr^{3+} B. V^{3+}
C. Ti^{3+} D. Sc^{3+}
- Q45. Noble gases do not react with other elements because they:
A. are mono-atomic
B. are not found in abundance
C. have size of their atoms very small
D. have completely paired up and stable electron shell
- Q46. Li resembles with Mg although they belong to different groups. This is because:
A. both occur together in nature
B. both have similar electronic configuration
C. The ratio of charge and size is approximately same for both elements
D. both are of approximately same size
- Q47. Hydrogen after losing one electron forms H^+ , it resembles in this property with:
A. alkali metals B. halogens
C. Carbon family D. alkaline earth metals
- Q48. The element with electronic configuration $3d^5 4s^1$ is:
A. metalloid B. non-metal
C. transition element D. noble gas
- Q49. The electronic configuration of neon is:
A. $1S^2$ B. $1S^2 2S^2 2P^6$
C. $1S^2 2S^2 2P^4$ D. $1S^2 2S^2 2P^3$
- Q50. Which element is alloyed with copper to form bronze?
A. Fe B. Mn
C. Sn D. Zn

Chemistry

- Q51. Predict the respect to the electronegativity if the elements are $1S^2, 2S^2, 2P^4$ respectively:
A. A is just
B. A is just
C. A is to
D. A is to
The element
- Q52. A. group I
B. group I
C. group I
D. period I
- Q53. Size of not terms of the
A. covalen
C. ionic ra
Which of th
incorrect:
A. $F^- < Cl^-$
C. $Na^+ < M^+$
- Q54. The remova
atom is best
A. bond en
C. electron
- Q55. The relation
ionization po
A. $I_1 < I_2$
C. $I_1 = I_2$
- Q56. In a given pe
A. the lowe
B. the smal
C. lowest d
D. all the ab
- Q57. The magniti
mainly on:
A. atomic s
C. screening
- Q58. As one desc
the electrone
A. remains
C. decrease
D. increase
decreases
- Q59. Among the a
forming pred
A. Ba
C. Sr
- Q60. Which of the
abundant in a
A. Kr
C. Ne

Chemistry

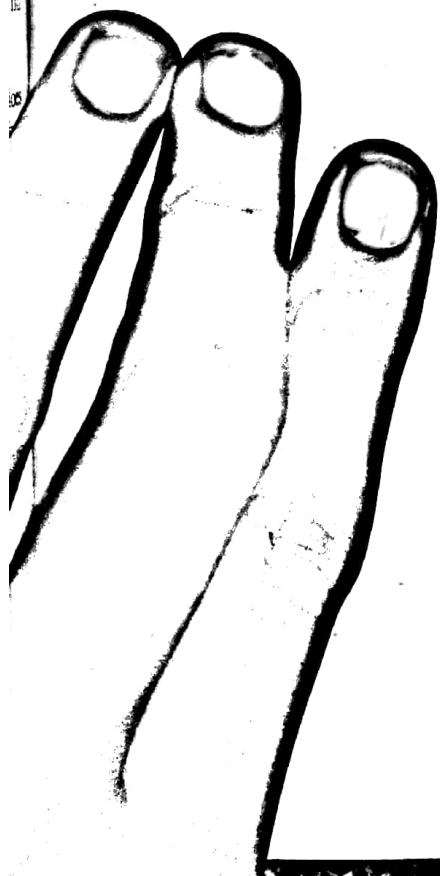
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- Q51. Predict the position of an element 'A' with respect to the element 'B' in the periodic table, if the electronic configuration of these elements are $1S^2, 2S^2, 2P^6, 3S^2, 3P^5$ and $1S^2, 2S^2, 2P^5$ respectively:
- A is just below element B
 - A is just above element B
 - A is to the left of B
 - A is to the right of B
- Q52. The element with atomic number 22 belongs to:
- group III & period 3
 - group IV & period 4
 - group III & period 4
 - period IV & group 4
- Q53. Size of noble gas atoms can be expressed in terms of their:
- covalent radii
 - Vander Waal's radii
 - ionic radii
 - none of these
- Q54. Which of the following order of ionic sizes is incorrect:
- $F^- < Cl^- < Br^-$
 - $Na^+ < F^- < O^{2-}$
 - $Na^+ < Mg^{2+} < Al^{3+}$
 - $Cl^- < S^{2-} < Se^{2-}$
- Q55. The removal of an electron from the gaseous atom is best described quantitatively in terms of:
- bond energy
 - ionization potential
 - electronegativity
 - electron affinity
- Q56. The relation between the first and second ionization potentials of a given atom is:
- $I_1 < I_2$
 - $I_1 > I_2$
 - $I_1 = I_2$
 - none of the above
- Q57. In a given period, the alkali metals have:
- the lowest ionization energy
 - the smallest atomic radius
 - lowest density
 - all the above three
- Q58. The magnitude of electron affinity depends mainly on:
- atomic size
 - nuclear charge
 - screening effect
 - all the above three
- Q59. As one descends a group in the periodic table, the electronegativity generally:
- remains constant
 - increases
 - decreases
 - increases up to a certain element & then decreases
- Q60. Among the alkaline earth metals, the element forming predominantly covalent compound is:
- Ba
 - Ca
 - Sr
 - Be
- Q61. Which of the following noble gases is the most abundant in atmosphere?
- Kr
 - Ar
 - Ne
 - He
- Q62. The gas with the highest ionization potential is:
- H
 - N
 - O
 - He
- Q63. Which of the following statements is correct?
- Helium is lighter than air
 - Neon is iso-electronic with helium
 - Argon is the rarest of the noble gases
 - Helium is heavier than air
- Q64. Electrical conductivity of Cs^+ is greater than Li^+ ion, because:
- Li^+ ion becomes highly hydrated
 - Cs^+ ion becomes highly hydrated
 - Cs^+ ion is least hydrated
 - Li^+ ion is least hydrated
- Q65. Alkali metals are powerful reducing agents, because:
- these are metals
 - these are monovalent
 - their ionic radii are large
 - their ionization potentials are low
- Q66. The most electropositive element among the alkaline earth metals is:
- Be
 - Mg
 - Ca
 - Ba
- Q67. Which of the following statements regarding BF_3 is not correct?
- It is an ionic compound
 - It is an electron-deficient compound
 - It is a Lewis acid
 - all are correct
- Q68. Graphite is a good conductor of electricity, because:
- all C-C bonds are satisfied
 - some of the electrons are free to move through crystal
 - it is soft
 - it has giant molecular structure
- Q69. An element with atomic number 12 is likely to have properties similar to those of the element with atomic number:
- 3
 - 8
 - 10
 - 22
- Q70. Diagonal relationship is shown by the:
- first few elements of 2nd period only
 - elements of 3rd period only
 - transition elements only
 - alkali metals only
- Q71. Both iron & aluminium form oxides which statement is true for both metal oxides?
- aluminium metal is destroyed by the oxide layer, while iron is protected by its oxide layer
 - both form an oxide layer which adheres to the metal very well
 - both oxides are soluble in water
 - aluminium is protected by its oxide layer while iron is consumed by the formation of the oxide layer

- Q72. Which is not a property of metals?
 A. They are generally solid at room temperature
 B. They tend to form covalent compounds with non-metals
 C. They generally have high melting points
 D. They are generally conductors of electricity
- Q73. Which is a method for the production of chlorine?
 A. Electrolysis of molten sodium chloride
 B. Crystallization of sodium chloride
 C. Electrolysis of aqueous sodium chloride
 D. Neutralization of hydrochloric acid
- Q74. Which statement is the best described the changes in elements from left to right in the periodic table?
 A. changes from metallic to less metallic
 B. atomic number decreases
 C. number of valence electrons decrease
 D. changes from a gas to a solid
- Q75. Which property of a particular element cannot be deduced from the periodic table?
 A. the charge of its ion
 B. the formula of its oxide
 C. the number of isotopes it has
 D. the number of valence electrons it has
- Q76. Hydrogen, helium and lithium are the first three elements of the periodic table. Their order in the periodic table is decided by:
 A. their classification as a metal or non-metal
 B. the mass of their atoms
 C. the number of electrons in the valence shell
 D. the number of protons in the nucleus
- Q77. Which elements has the greatest tendency to form a positive ion?
 A. sodium
 B. fluorine
 C. helium
 D. silver
- Q78. The formula of borax is:
 A. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$
 B. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
 C. $\text{Na}_2\text{B}_4\text{O}_7$
 D. $\text{Na}_2\text{B}_4\text{O}_7 \cdot 2\text{H}_2\text{O}$
- Q79. Which of the following has the maximum hydration energy?
 A. Be^{2+}
 B. Mg^{2+}
 C. Ca^{2+}
 D. Sr^{2+}
- Q80. The weakest base among the following is:
 A. NaOH
 B. KOH
 C. RbOH
 D. none of these
- Q81. The formula of plaster of paris is:
 A. $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
 B. $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
 C. CaSO_4
 D. $\text{CaSO}_4 \cdot 7\text{H}_2\text{O}$
- Q82. Which of the following is the transition element?
 A. Sr
 B. Sn
 C. Cr
 D. Ba
- Q83. Which is the important ore of copper?
 A. Malachite
 B. Bauxite
 C. Blue vitriol
 D. cryolite
- Q84. Which element is ferromagnetic?
 A. Cobalt
 B. Carbon
 C. Calcium
 D. Chromium
- Q85. Aluminium resists the process of corrosion due to the formation of:
 A. aluminium carbonate
 B. aluminium sulphate
 C. aluminium oxide
 D. aluminium nitrate
- Q86. The substance attracted by magnetic field is referred to:
 A. diamagnetic
 B. Paramagnetic
 C. ferromagnetic
 D. antimagnetic
- Q87. Which one of the following does not belong to d-block elements:
 A. Chromium
 B. Cobalt
 C. Silicon
 D. Zinc
- Q88. Which of the following statements about beryllium are true?
 A. Beryllium compounds tend to be covalent rather than ionic
 B. Beryllium shows a fixed oxidation number of +2 in its compounds
 C. Beryllium reacts rapidly with cold water
 D. A & B are correct
- Q89. Which of the following statements are correct for all three halogens, chlorine, bromine & iodine?
 A. They all forms hydrides which are strong acids in aqueous solution
 B. They all react with aqueous NaOH
 C. They all need to gain one electron to fill completely of their outer shells
 D. All are correct
- Q90. In which one of the following formulae does the transition element show the highest oxidation state?
 A. $\text{Cr}_2\text{O}_7^{2-}$
 B. CuCl_4^{2-}
 C. MnO_4^{2-}
 D. MnO_4^-
- Q91. The solubilities of the group II metal sulphates decreases as the proton number of the metal increases. Which factor affects this trend?
 A. the atomic radius of the metal atom
 B. the enthalpy change of formation of sulphate
 C. the enthalpy change of hydration of the metal ion
 D. the first ionization energy of the metal
- Q92. Elements of group IB are called:
 A. Coinage metals
 B. normal elements
 C. transition elements
 D. alkali metals
- Q93. The formula of heavy water is:
 A. H_2O
 B. D_2O
 C. ${}^1\text{H}^2$
 D. ${}^1\text{H}^3$

- Q94. Commercial hydrogen can be obtained by the action of steam on:
 A. marsh gas B. Coal gas
 C. Producer gas D. none of these
- Q95. A common ingredient of baking powder is:
 A. NaCl B. NaHCO_3
 C. Na_2CO_3 D. NaOH
- Q96. The only metal which is radioactive among alkali metals is?
 A. Rb B. Cs
 C. Fr D. Li
- Q97. Solvay's process is used for the manufacture of:
 A. Na B. NaOH
 C. NaCl D. Na_2CO_3

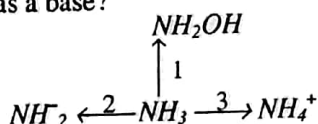
- Q98. Which of the following metals is extracted by electrolytic reduction method:
 A. Al B. Cu
 C. Fe D. All of the above
- Q99. Which of the following elements does not show allotropy?
 A. C B. S
 C. Sn D. Pb
- Q100. IUPAC name of $[\text{Ni}(\text{CO})_4]$ is:
 A. Nickel carbonyl (0)
 B. Tetracarbonyl nickel
 C. Tetracarbonylnickel (0)
 D. none of the above



INORGANIC CHEMISTRY

MISCELLANEOUS EXERCISE

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Inorganic Chemistry (Miscellaneous Ex)

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Chemistry

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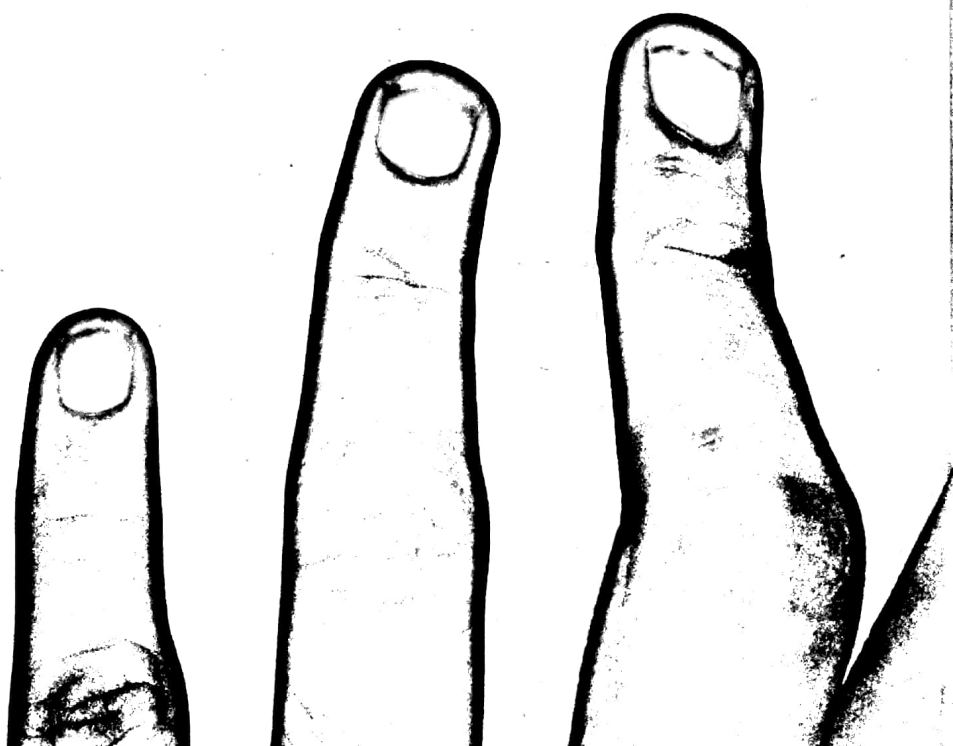
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- Which is not a mineral of aluminium:
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 C. Corundum D. diaspore
- Glass is soluble in:
 A. H_2SO_4 B. $HClO_4$
 C. HF D. aqua regia
- Diamond and graphite are:
 A. isomers B. allotropes
 C. isotopes D. polymers
- Water gas is an important industrial fuel. It is a mixture of:
 A. $H_2O + air$ B. $CO + H_2$
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 C. Chlorine D. iodine
- Q42. Helium is used in balloons instead of hydrogen because it is:
 A. lighter than hydrogen B. incombustible
 C. more abundant than hydrogen
 D. radioactive and easily detected
- Q43. Some metals occur in the native form because of their:
 A. high reactivity B. low reactivity
 C. high electronegativity D. low density
- Q44. Which one of the following metal ions is diamagnetic?
 A. Cr^{3+} B. V^{3+}
 C. Ti^{3+} D. Sc^{3+}
- Q45. Noble gases do not react with other elements because they:
 A. are mono-atomic
 B. are not found in abundance
 C. have size of their atoms very small
 D. have completely paired up and stable electron shell
- Q46. Li resembles with Mg although they belong to different groups. This is because:
 A. both occur together in nature
 B. both have similar electronic configuration
 C. The ratio of charge and size is approximately same for both elements
 D. both are of approximately same size
- Q47. Hydrogen after losing one electron forms H^+ , it resembles in this property with:
 A. alkali metals B. halogens
 C. Carbon family D. alkaline earth metals
- Q48. The element with electronic configuration $3d^5 4s^1$ is:
 A. metalloid B. non-metal
 C. transition element D. noble gas
- Q49. The electronic configuration of neon is:
 A. $1s^2$ B. $1s^2, 2s^2, 2p^6$
 C. $1s^2, 2s^2, 2p^4$ D. $1s^2, 2s^2, 2p^3$
- Q50. Which element is alloyed with copper to form bronze?
 A. Fe B. Mn
 C. Sn D. Zn

- Q51. Predict the position of an element 'A' with respect to the element 'B' in the periodic table, if the electronic configuration of these elements are $1S^2, 2S^2, 2P^6, 3S^2, 3P^5$ and $1S^2, 2S^2, 2P^5$ respectively:
- A is just below element B
 - A is just above element B
 - A is to the left of B
 - A is to the right of B
- Q52. The element with atomic number 22 belongs to:
- group III & period 3
 - group IV & period 4
 - group III & period 4
 - period IV & group 4
- Q53. Size of noble gas atoms can be expressed in terms of their:
- covalent radii
 - Vander Waal's radii
 - ionic radii
 - none of these
- Q54. Which of the following order of ionic sizes is incorrect:
- $F^- < Cl^- < Br^-$
 - $Na^+ < F^- < O^{2-}$
 - $Na^+ < Mg^{2+} < Al^{3+}$
 - $Cl^- < S^{2-} < Se^{2-}$
- Q55. The removal of an electron from the gaseous atom is best described quantitatively in terms of:
- bond energy
 - ionization potential
 - electronegativity
 - electron affinity
- Q56. The relation between the first and second ionization potentials of a given atom is:
- $I_1 < I_2$
 - $I_1 > I_2$
 - $I_1 = I_2$
 - none of the above
- Q57. In a given period, the alkali metals have:
- the lowest ionization energy
 - the smallest atomic radius
 - lowest density
 - all the above three
- Q58. The magnitude of electron affinity depends mainly on:
- atomic size
 - nuclear charge
 - screening effect
 - all the above three
- Q59. As one descends a group in the periodic table, the electronegativity generally:
- remains constant
 - increases
 - decreases
 - increases up to a certain element & then decreases
- Q60. Among the alkaline earth metals, the element forming predominantly covalent compound is:
- Ba
 - Ca
 - Sr
 - Be
- Q61. Which of the following noble gases is the most abundant in atmosphere?
- Kr
 - Ar
 - Ne
 - He
- Q62. The gas with the highest ionization potential is:
- H
 - N
 - O
 - He
- Q63. Which of the following statements is correct?
- Helium is lighter than air
 - Neon is iso-electronic with helium
 - Argon is the rarest of the noble gases
 - Helium is heavier than air
- Q64. Electrical conductivity of Cs^+ is greater than Li^+ ion, because:
- Li^+ ion becomes highly hydrated
 - Cs^+ ion becomes highly hydrated
 - Cs^+ ion is least hydrated
 - Li^+ ion is least hydrated
- Q65. Alkali metals are powerful reducing agents, because:
- these are metals
 - these are monovalent
 - their ionic radii are large
 - their ionization potentials are low
- Q66. The most electropositive element among the alkaline earth metals is:
- Be
 - Mg
 - Ca
 - Ba
- Q67. Which of the following statements regarding BF_3 is not correct?
- It is an ionic compound
 - It is an electron-deficient compound
 - It is a Lewis acid
 - all are correct
- Q68. Graphite is a good conductor of electricity, because:
- all C-C bonds are satisfied
 - some of the electrons are free to move through crystal
 - it is soft
 - it has giant molecular structure
- Q69. An element with atomic number 12 is likely to have properties similar to those of the element with atomic number:
- 3
 - 8
 - 10
 - 22
- Q70. Diagonal relationship is shown by the:
- first few elements of 2nd period only
 - elements of 3rd period only
 - transition elements only
 - alkali metals only
- Q71. Both iron & aluminium form oxides which statement is true for both metal oxides?
- aluminium metal is destroyed by the oxide layer, while iron is protected by its oxide layer
 - both form an oxide layer which adheres to the metal very well
 - both oxides are soluble in water
 - aluminium is protected by its oxide layer while iron is consumed by the formation of the oxide layer

- Q72. Which is not a property of metals?
- They are generally solid at room temperature
 - They tend to form covalent compounds with non-metals
 - They generally have high melting points
 - They are generally conductors of electricity
- Q73. Which is a method for the production of chlorine?
- Electrolysis of molten sodium chloride
 - Crystallization of sodium chloride
 - Electrolysis of aqueous sodium chloride
 - Neutralization of hydrochloric acid
- Q74. Which statement is the best described the changes in elements from left to right in the periodic table?
- changes from metallic to less metallic
 - atomic number decreases
 - number of valence electrons decrease
 - changes from a gas to a solid
- Q75. Which property of a particular element cannot be deduced from the periodic table?
- the charge of its ion
 - the formula of its oxide
 - the number of isotopes it has
 - the number of valence electrons it has
- Q76. Hydrogen, helium and lithium are the first three elements of the periodic table. Their order in the periodic table is decided by:
- their classification as a metal or non-metal
 - the mass of their atoms
 - the number of electrons in the valence shell
 - the number of protons in the nucleus
- Q77. Which elements has the greatest tendency to form a positive ion?
- sodium
 - fluorine
 - helium
 - silver
- Q78. The formula of borax is:
- $\text{Na}_2\text{B}_4\text{O}_7 \cdot 5\text{H}_2\text{O}$
 - $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$
 - $\text{Na}_2\text{B}_4\text{O}_7$
 - $\text{Na}_2\text{B}_4\text{O}_7 \cdot 2\text{H}_2\text{O}$
- Q79. Which of the following has the maximum hydration energy?
- Be^{2+}
 - Mg^{2+}
 - Ca^{2+}
 - Sr^{2+}
- Q80. The weakest base among the following is:
- NaOH
 - KOH
 - RbOH
 - none of these
- Q81. The formula of plaster of paris is:
- $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
 - $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
 - CaSO_4
 - $\text{CaSO}_4 \cdot 7\text{H}_2\text{O}$
- Q82. Which of the following is the transition element?
- Sr
 - Sn
 - Cr
 - Ba

- Q83. Which is the important ore of copper?
- Malachite
 - Bauxite
 - Blue vitriol
 - cryolite
- Q84. Which element is ferromagnetic?
- Cobalt
 - Carbon
 - Calcium
 - Chromium
- Q85. Aluminium resists the process of corrosion due to the formation of:
- aluminium carbonate
 - aluminium sulphate
 - aluminium oxide
 - aluminium nitrate
- Q86. The substance attracted by magnetic field is referred to:
- diamagnetic
 - Paramagnetic
 - ferromagnetic
 - antimagnetic
- Q87. Which one of the following does not belong to d-block elements:
- Chromium
 - Cobalt
 - Silicon
 - Zinc
- Q88. Which of the following statements about beryllium are true?
- Beryllium compounds tend to be covalent rather than ionic
 - Beryllium shows a fixed oxidation number of +2 in its compounds
 - Beryllium reacts rapidly with cold water
 - A & B are correct
- Q89. Which of the following statements are correct for all three halogens, chlorine, bromine & iodine?
- They all forms hydrides which are strong acids in aqueous solution
 - They all react with aqueous NaOH
 - They all need to gain one electron to fill completely of their outer shells
 - All are correct
- Q90. In which one of the following formulae does the transition element show the highest oxidation state?
- $\text{Cr}_2\text{O}_7^{2-}$
 - CuCl_4^{2-}
 - MnO_4^{2-}
 - MnO_4^-
- Q91. The solubilities of the group II metal sulphates decreases as the proton number of the metal increases. Which factor affects this trend?
- the atomic radius of the metal atom
 - the enthalpy change of formation of sulphate
 - the enthalpy change of hydration of the metal ion
 - the first ionization energy of the metal
- Q92. Elements of group IB are called:
- Coinage metals
 - normal elements
 - transition elements
 - alkali metals
- Q93. The formula of heavy water is:
- H_2O
 - D_2O
 - ${}_1\text{H}^2$
 - ${}_1\text{H}^3$

- Q94. Commercial hydrogen can be obtained by the action of steam on:
A. marsh gas B. Coal gas
C. Producer gas D. none of these
- Q95. A common ingredient of baking powder is:
A. NaCl B. NaHCO_3
C. Na_2CO_3 D. NaOH
- Q96. The only metal which is radioactive among alkali metals is?
A. Rb B. Cs
C. Fr D. Li
- Q97. Solvay's process is used for the manufacture of:
A. Na B. NaOH
C. NaCl D. Na_2CO_3
- Q98. Which of the following metals is extracted by electrolytic reduction method:
A. Al B. Cu
C. Fe D. All of the above
- Q99. Which of the following elements does not show allotropy?
A. C B. S
C. Sn D. Pb
- Q100. IUPAC name of $[\text{Ni}(\text{CO})_4]$ is:
A. Nickel carbonyl (0)
B. Tetracarbonyl nickel
C. Tetracarbonylnickel (0)
D. none of the above



PHYSICAL CHEMISTRY

MISCELLANEOUS EXERCISE

429

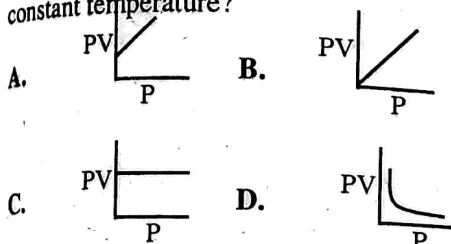
Q01. The p^H of a solution is 12.3. The hydroxide ion concentration in mol. dm^{-3} is:

- A. 0.0199 B. 0.05
C. 0.005 D. 0.199

Q02. Which gas is likely to deviate most from ideal gas behaviour?

- A. He B. N_2
C. HCl D. H_2

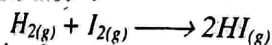
Q03. Which curve shows the correct graph of PV against P for a fixed mass of an ideal gas at constant temperature?



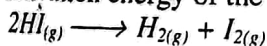
Q04. The energy of an electron is specified by:

- A. azimuthal quantum number
B. magnetic quantum number
C. principal quantum number
D. spin quantum number

Q05. The reaction below has an activation energy of $+173.2 \text{ kJ mol}^{-1}$.

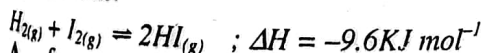


The activation energy of the reverse reaction is:



- A. $+182.8 \text{ kJ mol}^{-1}$ B. $163.6 \text{ kJ mol}^{-1}$
C. $+9.6 \text{ kJ mol}^{-1}$ D. $-173.2 \text{ kJ mol}^{-1}$

Q06. What effect will this increase in temperature have on the position of the following equilibrium?



- A. forward reaction favourable
B. reverse reaction favourable
C. equilibrium is maintained
D. reaction is completed

Q07. The numerical value of the solubility product of calcium sulphate is 2.5×10^{-5} . What is the molar concentration of sulphate ions in solution:

- A. 2.5×10^{-4} B. 0.100
C. 5.0×10^{-3} D. 0.200

Q08. Which property is the same for the two nuclides $^{40}_{18}\text{Ar}$ & $^{40}_{19}\text{K}$?

- A. the number of electrons
B. the number of neutrons
C. the number of nucleons
D. the number of protons

Q09. For a hydrogen electrode what would have to be changed to make the standard hydrogen electrode, having $E^\circ = 0.00 \text{ V}$?

- A. the concentration of the hydrochloric acid
B. the metal comprising the electrode
C. the thickness of the layer of platinum black
D. the temp. both of the gas and of the acid solution

Q10. What kind of orbital must an electron with the principle quantum number $n=2$ occupy?

- A. a spherically-shaped orbital
B. either an s or p orbital
C. the orbital closest to the nucleus
D. a dumb-bell shaped orbital

Q11. For which equilibrium will both of these changes (the pressure is reduced & temperature is increased) result in an increase in the proportion of products?

- A. $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)} ; \Delta H = 53 \text{ kJ mol}^{-1}$
B. $4\text{NH}_{3(g)} + 5\text{O}_{2(g)} \rightleftharpoons 4\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(g)} ; \Delta H = -950 \text{ kJ mol}^{-1}$
C. $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightleftharpoons 2\text{NH}_{3(g)} ; \Delta H = -92 \text{ kJ mol}^{-1}$
D. $\text{N}_2\text{O}_{4(g)} \rightleftharpoons 2\text{NO}_{2(g)} ; \Delta H = +57 \text{ kJ mol}^{-1}$

Q12. What is the proton (atomic) number of an element that has four unpaired electrons in its ground state:

- A. 6 B. 14
C. 26 D. 16

Q13. Which one of the following substances has a linear molecule?

- A. Hydrogen sulphide
B. Carbon dioxide
C. Sulphur dioxide
D. nitrogen oxide

Q14. Under what conditions of temperature and pressure will a real gas behave most like an ideal gas?

Temperature	Pressure
A. low	low
B. low	high
C. high	low
D. high	high

Q15. The enthalpy change ΔH associated with a chemical change does not depend upon:

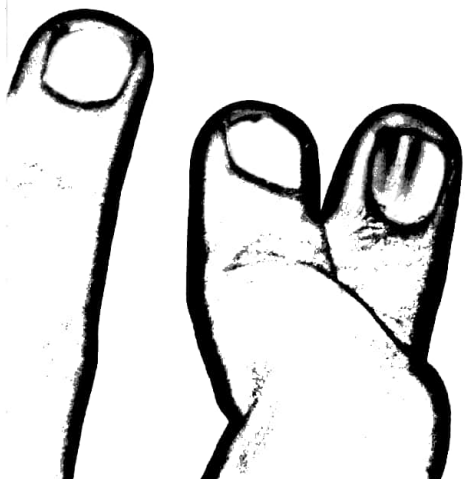
- A. the number of stages involved in the change
B. the temperature at which the change occurs
C. the volume of the reactants
D. all of the above

- Q16. Which is the lightest among the following?
 A. an atom of hydrogen B. an electron
 C. a neutron D. a proton
- Q17. The following standard half cells are connected:
 $\text{Cd}^{2+}_{(aq)} + 2e^- \rightleftharpoons \text{Cd}_{(s)}; E^\circ = -0.40\text{V}$
 $\text{Ag}^+_{(aq)} + e^- \rightleftharpoons \text{Ag}_{(s)}; E^\circ = -0.80\text{V}$
 What is the potential of the cadmium electrode relative to the silver electrode?
 A. -2.00V B. -0.40V
 C. $+1.20\text{V}$ D. -1.20V
- Q18. Which one of the following is necessarily the rate determining step of a reaction?
 A. the slowest B. the fastest
 C. the first D. the final
- Q19. Which one of the following correctly represents the units of the rate constant K for a first order reaction?
 A. mol dm^{-3} B. S^{-1}
 C. $\text{mol}^{-1} \text{dm}^{-3} \text{S}^{-1}$ D. $\text{mol dm}^{-3} \text{S}^{-1}$
- Q20. If the reaction: $A + B \longrightarrow C + D$ is described as being of zero order with respect to A , it means that:
 A. A is catalyst in this reaction
 B. the concentration of A does not change during the reaction
 C. the rate of reaction is independent of the concentration of A
 D. the rate of reaction is proportional to the concentration of B
- Q21. Which of the following is not a characteristic of a π bond?
 A. A π bond is formed when a sigma bond already present
 B. π bonds are obtained from hybrid orbitals
 C. π bonds results from lateral overlap of atomic orbitals
 D. All of the above
- Q22. The mass law states that the rate of a reaction is directly proportional to the:
 A. equilibrium constant
 B. molar concentrations of the reactants
 C. nature of the reactants
 D. volume of the container
- Q23. Which of the following geometries corresponds to sp^3d^2 hybridization?
 A. Octahedral B. tetrahedral
 C. square planar D. trigonal pyramidal
- Q24. The entropy for a spontaneous process is:
 A. negative B. positive
 C. Zero D. none of the above
- Q25. One molal solution of glucose (molecular weight = 180) will contain 1 mole of glucose in:
 A. 100g of water B. 180g of water
 C. 1000g of water D. 10Kg of water
- Q26. Which of the following is not a colligative property?
 A. depression of freezing point
 B. elevation of boiling point
 C. density D. Osmotic pressure
- Q27. In the reaction, $\text{NH}_4^+ + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{NH}_3$, the conjugate base of H_3O^+ ion is:
 A. NH_4^+ B. H_2O
 C. H^+ D. NH_3
- Q28. Which of the following is not a buffer solution?
 A. $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$
 B. $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$
 C. $\text{NH}_4\text{Cl} + \text{HCl}$
 D. all of these
- Q29. The ionic character of a covalent bond is due to the difference of bond forming elements is:
 A. atomic radii B. electron affinities
 C. electronegativities D. Oxidation states
- Q30. How many alpha particles are emitted in the nuclear transformation: $^{215}_{84}\text{Po} \longrightarrow ^{211}_{82}\text{Pb}$
 A. Zero B. One
 C. two D. four
- Q31. According to pauli's exclusion principle, no two electrons in an atom can:
 A. be present in the same orbital
 B. have the same spin
 C. interact with each other
 D. have the same set of quantum number
- Q32. The most favourable conditions for ionic bonding are:
 A. high charge on ions, large cation, small anion
 B. high charge on ions, small cation, large anion
 C. low charge on ions, large cation, large anion
 D. low charge on ions, large cation, small anion
- Q33. The enthalpy change for the reaction is called:
 $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$
 A. enthalpy of formation
 B. enthalpy of neutralization
 C. enthalpy of reaction
 D. enthalpy of fusion
- Q34. For the exothermic reaction, $2\text{NO}_{(g)} \rightleftharpoons \text{N}_{2(g)} + \text{O}_{2(g)} + \text{heat}$
 A. K is independent of temperature B. K increases as temperature increases
 C. K decreases as temperature increases
 D. K varies with the addition of N_2 or O_2
- Q35. The ability of a given substance to assume two or more crystalline structures is called:
 A. polymorphism B. polymerization
 C. isomorphism D. isomerism

Chemistry
 Q36. Electro... and anion...
 A. hy...
 C. cha...
 Which...
 Q37. molecu...
 A. It i...
 conc...
 B. It m...
 C. It is...
 react...
 chem...
 D. It is...
 A press...
 because t...
 Q38. A. boili...
 B. heat...
 C. high...
 D. all an...
 Q39. For the re...
 experiment...
 What is the...
 A. 2
 C. 3/2
 Q40. Most crys...
 their atoms...
 A. arrang...
 B. spheri...
 C. strong...
 D. none o...
 Q41. Which of...
 particles of...
 A. alpha r...
 C. gamma...
 Q42. Heat of com...
 A. Positive...
 C. may be...
 D. zero

- Q36. Electrolysis is a process in which the cations and anions of the electrolyte are:
 A. hydrated B. hydrolyzed
 C. charged D. discharged
- Q37. Which of the following stands true for molecularity of a reaction?
 A. It is the sum of exponents of molar concentration of the reactants
 B. It may have a fraction value
 C. It is the number of molecules of the reactants taking part in a single step chemical reaction
 D. It is determined experimentally
- Q38. A pressure cooker reduces cooking time because the:
 A. boiling point is elevated
 B. heat is more evenly distributed
 C. higher pressure tenderizes the food
 D. all are correct
- Q39. For the reaction: $H_{2(g)} + Br_{2(g)} \longrightarrow 2HBr_{(g)}$ the experimental data suggest $Rate = K[H_2][Br_2]^{1/2}$. What is the molecularity of the reaction?
 A. 2 B. 1/2
 C. 3/2 D. 1
- Q40. Most crystals show good cleavage because their atoms, ions or molecules are:
 A. arranged in planes
 B. spherically symmetrical
 C. strongly bonded together
 D. none of these
- Q41. Which of the following do not consists of particles of matter?
 A. alpha rays B. beta rays
 C. gamma rays D. all of these
- Q42. Heat of combustion is:
 A. Positive B. always negative
 C. may be Positive or negative
 D. zero

- Q43. Which of the following bonds will be most polar?
 A. O-F B. N-Cl
 C. C-F D. N-N
- Q44. Which statement for equilibrium constant is true for the reaction, $A + B \rightleftharpoons C$.
 A. not changes with temperature
 B. changes when catalyst is added
 C. Increases with temperature
 D. changes with temperature
- Q45. The p^H of 0.0001M NaOH is:
 A. 4 B. 10
 C. 12 D. 11
- Q46. Which is not emitted by radioactive substance?
 A. α - rays B. β - rays
 C. Positron D. Proton
- Q47. Which is not affected by temperature?
 A. normality B. molarity
 C. molality D. all of these
- Q48. First law of thermodynamics is represented by the equations:
 A. $\Delta E = q + w$ B. $\Delta E = q - w$
 C. $w = q + \Delta E$ D. $\Delta E = q + P\Delta V$
- Q49. Which contains both polar and non-polar bonds?
 A. NH_4Cl B. HCN
 C. CH_4 D. none of these
- Q50. The mass of a neutron is:
 A. same as that of an electron
 B. same as that of a positron
 C. slightly less than that of an electron
 D. slightly more than that of a proton



Topic 10 CHEMICAL KINETICS

Q.	01.	→	B
Q.	02.	→	D
Q.	03.	→	D
Q.	04.	→	A
Q.	05.	→	B
Q.	06.	→	A
Q.	07.	→	B
Q.	08.	→	C
Q.	09.	→	B
Q.	10.	→	C
Q.	11.	→	A
Q.	12.	→	B
Q.	13.	→	D
Q.	14.	→	B
Q.	15.	→	D
Q.	16.	→	B
Q.	17.	→	B
Q.	18.	→	A
Q.	19.	→	B
Q.	20.	→	D
Q.	21.	→	C
Q.	22.	→	A
Q.	23.	→	C
Q.	24.	→	A
Q.	25.	→	C
Q.	26.	→	D
Q.	27.	→	C
Q.	28.	→	C
Q.	29.	→	B
Q.	30.	→	B
Q.	31.	→	B
Q.	32.	→	C
Q.	33.	→	C
Q.	34.	→	A
Q.	35.	→	C
Q.	36.	→	B
Q.	37.	→	C
Q.	38.	→	A
Q.	39.	→	D
Q.	40.	→	A
Q.	41.	→	B
Q.	42.	→	B
Q.	43.	→	A
Q.	44.	→	C
Q.	45.	→	B
Q.	46.	→	D

Q.	47.	→	C
Q.	48.	→	C
Q.	49.	→	B
Q.	50.	→	C
Q.	51.	→	D
Q.	52.	→	A
Q.	53.	→	A
Q.	54.	→	A
Q.	55.	→	B
Q.	56.	→	D
Q.	57.	→	C
Q.	58.	→	A
Q.	59.	→	B
Q.	60.	→	D
Q.	61.	→	A
Q.	62.	→	A

Topic 11 PERIODIC TABLE

Q.	01.	→	C
Q.	02.	→	A
Q.	03.	→	D
Q.	04.	→	C
Q.	05.	→	B
Q.	06.	→	A
Q.	07.	→	C
Q.	08.	→	D
Q.	09.	→	B
Q.	10.	→	B
Q.	11.	→	D
Q.	12.	→	A
Q.	13.	→	B
Q.	14.	→	B
Q.	15.	→	D
Q.	16.	→	A
Q.	17.	→	C
Q.	18.	→	D
Q.	19.	→	B
Q.	20.	→	C
Q.	21.	→	D
Q.	22.	→	C
Q.	23.	→	A
Q.	24.	→	B
Q.	25.	→	A
Q.	26.	→	B
Q.	27.	→	C
Q.	28.	→	C
Q.	29.	→	A
Q.	30.	→	D

Q.	31.	→	C
Q.	32.	→	D
Q.	33.	→	B
Q.	34.	→	A
Q.	35.	→	B
Q.	36.	→	C
Q.	37.	→	C
Q.	38.	→	D
Q.	39.	→	D
Q.	40.	→	B
Q.	41.	→	A
Q.	42.	→	B
Q.	43.	→	C
Q.	44.	→	A
Q.	45.	→	C
Q.	46.	→	C
Q.	47.	→	A
Q.	48.	→	B
Q.	49.	→	A
Q.	50.	→	B
Q.	51.	→	B
Q.	52.	→	C
Q.	53.	→	C
Q.	54.	→	B
Q.	55.	→	D
Q.	56.	→	A
Q.	57.	→	A
Q.	58.	→	D
Q.	59.	→	B
Q.	60.	→	A
Q.	61.	→	B
Q.	62.	→	A
Q.	63.	→	D
Q.	64.	→	B
Q.	65.	→	D
Q.	66.	→	B
Q.	67.	→	B
Q.	68.	→	D
Q.	69.	→	C
Q.	70.	→	B

Topic 12 HYDROGEN & WATER

Q.	01.	→	D
Q.	02.	→	B
Q.	03.	→	A
Q.	04.	→	B
Q.	05.	→	D
Q.	06.	→	B

Topic 13**Group IA****Elements**

(Alkali Metals)

Q.	01.	→	B
Q.	02.	→	C
Q.	03.	→	C
Q.	04.	→	C
Q.	05.	→	D
Q.	06.	→	A
Q.	07.	→	A
Q.	08.	→	C
Q.	09.	→	D
Q.	10.	→	A
Q.	11.	→	B
Q.	12.	→	B
Q.	13.	→	C
Q.	14.	→	A
Q.	15.	→	D
Q.	16.	→	B
Q.	17.	→	C
Q.	18.	→	D
Q.	19.	→	D
Q.	20.	→	A
Q.	21.	→	B
Q.	22.	→	A
Q.	23.	→	C
Q.	24.	→	A
Q.	25.	→	A
Q.	26.	→	B
Q.	27.	→	A
Q.	28.	→	C
Q.	29.	→	A
Q.	30.	→	D
Q.	31.	→	B
Q.	32.	→	A
Q.	33.	→	C
Q.	34.	→	A
Q.	35.	→	B
Q.	36.	→	C
Q.	37.	→	B
Q.	38.	→	B
Q.	39.	→	B
Q.	40.	→	B
Q.	41.	→	C
Q.	42.	→	A
Q.	43.	→	C
Q.	44.	→	B
Q.	45.	→	D

Topic 14**Group IIA****Elements**

(Alkaline Earth Metals)

Q.	01.	→	C
Q.	02.	→	B
Q.	03.	→	A
Q.	04.	→	B
Q.	05.	→	A
Q.	06.	→	A
Q.	07.	→	B
Q.	08.	→	C
Q.	09.	→	B
Q.	10.	→	B
Q.	11.	→	B
Q.	12.	→	A
Q.	13.	→	B
Q.	14.	→	D
Q.	15.	→	C
Q.	16.	→	C
Q.	17.	→	B
Q.	18.	→	C
Q.	19.	→	D
Q.	20.	→	D
Q.	21.	→	B
Q.	22.	→	A
Q.	23.	→	D
Q.	24.	→	C
Q.	25.	→	A
Q.	26.	→	A
Q.	27.	→	A
Q.	28.	→	C
Q.	29.	→	B
Q.	30.	→	A

Topic 15**Group IIIA****Elements**

(Boron Family)

Q.	01.	→	B
Q.	02.	→	B
Q.	03.	→	C
Q.	04.	→	D
Q.	05.	→	B
Q.	06.	→	D
Q.	07.	→	B
Q.	08.	→	C
Q.	09.	→	B
Q.	10.	→	A
Q.	11.	→	A

Q.	12.	→	B
Q.	13.	→	C
Q.	14.	→	A
Q.	15.	→	A
Q.	16.	→	C
Q.	17.	→	B
Q.	18.	→	C
Q.	19.	→	C
Q.	20.	→	D
Q.	21.	→	A
Q.	22.	→	D
Q.	23.	→	A
Q.	24.	→	A
Q.	25.	→	B
Q.	26.	→	B
Q.	27.	→	A
Q.	28.	→	B
Q.	29.	→	A
Q.	30.	→	C
Q.	31.	→	A
Q.	32.	→	B
Q.	33.	→	C
Q.	34.	→	C
Q.	35.	→	D
Q.	36.	→	B
Q.	37.	→	A
Q.	38.	→	B
Q.	39.	→	C
Q.	40.	→	C
Q.	41.	→	B
Q.	42.	→	C
Q.	43.	→	C
Q.	44.	→	A
Q.	45.	→	B
Q.	46.	→	A
Q.	47.	→	B
Q.	48.	→	B
Q.	49.	→	C
Q.	50.	→	D
Q.	51.	→	C
Q.	52.	→	B
Q.	53.	→	B
Q.	54.	→	D
Q.	55.	→	C
Q.	56.	→	C
Q.	57.	→	B
Q.	58.	→	C
Q.	59.	→	C
Q.	60.	→	A

Topic 16**Group IVA****Elements**

(Carbon Family)

Q.	01.	→	D
Q.	02.	→	C
Q.	03.	→	B
Q.	04.	→	B
Q.	05.	→	A
Q.	06.	→	A
Q.	07.	→	C
Q.	08.	→	B
Q.	09.	→	D
Q.	10.	→	A
Q.	11.	→	C
Q.	12.	→	A
Q.	13.	→	C
Q.	14.	→	B
Q.	15.	→	A
Q.	16.	→	C
Q.	17.	→	C
Q.	18.	→	A
Q.	19.	→	B
Q.	20.	→	A
Q.	21.	→	B
Q.	22.	→	B
Q.	23.	→	C
Q.	24.	→	B
Q.	25.	→	C
Q.	26.	→	B
Q.	27.	→	B
Q.	28.	→	D
Q.	29.	→	A
Q.	30.	→	B
Q.	31.	→	B
Q.	32.	→	C
Q.	33.	→	C
Q.	34.	→	D
Q.	35.	→	A
Q.	36.	→	D

Topic 17**Group VA****Elements**

(Nitrogen Family)

Q.	01.	→	B
Q.	02.	→	A
Q.	03.	→	D
Q.	04.	→	C
Q.	05.	→	D

Q.	06.	→	A
Q.	07.	→	B
Q.	08.	→	C
Q.	09.	→	A
Q.	10.	→	B
Q.	11.	→	A
Q.	12.	→	B
Q.	13.	→	C
Q.	14.	→	B
Q.	15.	→	C
Q.	16.	→	C
Q.	17.	→	A
Q.	18.	→	B
Q.	19.	→	C
Q.	20.	→	A
Q.	21.	→	B
Q.	22.	→	D
Q.	23.	→	B
Q.	24.	→	A
Q.	25.	→	C

Topic 18**Group VIA****Elements**

(Oxygen Family)

Q.	01.	→	A
Q.	02.	→	C
Q.	03.	→	B
Q.	04.	→	B
Q.	05.	→	C
Q.	06.	→	A
Q.	07.	→	C
Q.	08.	→	D
Q.	09.	→	D
Q.	10.	→	B
Q.	11.	→	A
Q.	12.	→	B
Q.	13.	→	C
Q.	14.	→	C
Q.	15.	→	D
Q.	16.	→	A
Q.	17.	→	C
Q.	18.	→	A
Q.	19.	→	C
Q.	20.	→	A
Q.	21.	→	B
Q.	22.	→	D
Q.	23.	→	C
Q.	24.	→	C
Q.	25.	→	B
Q.	26.	→	C

Chemistry

A
B
C
A
B
A
C
B
C
C
A
B
C
C
A
B
D
B
A
C

A
C
B
B
C
A
C
D
D
B
A
B
C
C
D
A
C
A
C
A
B
D
C
C
B
C

Chemistry

Q. 27. → B
Q. 28. → B
Q. 29. → C
Q. 30. → D
Q. 31. → D
Q. 32. → C
Q. 33. → B
Q. 34. → A
Q. 35. → B

Topic 19

Group VIIA

Elements

(Halogens Family)

Q. 01. → C
Q. 02. → D
Q. 03. → A
Q. 04. → A
Q. 05. → B
Q. 06. → A
Q. 07. → A
Q. 08. → C
Q. 09. → D
Q. 10. → A
Q. 11. → B
Q. 12. → A
Q. 13. → B
Q. 14. → A
Q. 15. → D
Q. 16. → D
Q. 17. → B
Q. 18. → D
Q. 19. → C
Q. 20. → A
Q. 21. → D
Q. 22. → B
Q. 23. → D
Q. 24. → D

Topic 20

Zero Group

Elements

(Inert Gases)

Q. 01. → B
Q. 02. → A
Q. 03. → C
Q. 04. → A
Q. 05. → B
Q. 06. → A
Q. 07. → B
Q. 08. → B

Q. 09. → C
Q. 10. → A
Q. 11. → D
Q. 12. → C
Q. 13. → A
Q. 14. → C
Q. 15. → D
Q. 16. → D
Q. 17. → D
Q. 18. → A
Q. 19. → C
Q. 20. → A
Q. 21. → C
Q. 22. → D
Q. 23. → B
Q. 24. → C
Q. 25. → A
Q. 26. → D

Topic 21

d-Block

Elements

(Transition Metals)

Q. 01. → D
Q. 02. → C
Q. 03. → A
Q. 04. → D
Q. 05. → B
Q. 06. → A
Q. 07. → C
Q. 08. → A
Q. 09. → D
Q. 10. → C
Q. 11. → B
Q. 12. → A
Q. 13. → C
Q. 14. → A
Q. 15. → B
Q. 16. → C
Q. 17. → D
Q. 18. → C
Q. 19. → B
Q. 20. → C
Q. 21. → D
Q. 22. → C
Q. 23. → B
Q. 24. → C
Q. 25. → D
Q. 26. → A
Q. 27. → C
Q. 28. → B

Q. 29. → C
Q. 30. → D
Q. 31. → A

Topic 22

Introduction To

Organic

Chemistry

Q. 01. → B
Q. 02. → D
Q. 03. → A
Q. 04. → C
Q. 05. → B
Q. 06. → D
Q. 07. → B
Q. 08. → C
Q. 09. → A
Q. 10. → B
Q. 11. → C
Q. 12. → B
Q. 13. → C
Q. 14. → B
Q. 15. → C
Q. 16. → C
Q. 17. → D
Q. 18. → B
Q. 19. → C
Q. 20. → D
Q. 21. → A
Q. 22. → C
Q. 23. → B
Q. 24. → A
Q. 25. → B
Q. 26. → C
Q. 27. → B
Q. 28. → C
Q. 29. → C
Q. 30. → A
Q. 31. → C
Q. 32. → A
Q. 33. → A
Q. 34. → B
Q. 35. → A
Q. 36. → B
Q. 37. → A
Q. 38. → C
Q. 39. → A
Q. 40. → D
Q. 41. → C
Q. 42. → A

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Q.	43.	→	D
Q.	44.	→	A
Q.	45.	→	D
Q.	46.	→	D
Q.	47.	→	B
Q.	48.	→	B
Q.	49.	→	B
Q.	50.	→	B

Topic 23
Chemistry Of
Hydrocarbons

Q.	01.	→	C
Q.	02.	→	C
Q.	03.	→	A
Q.	04.	→	B
Q.	05.	→	C
Q.	06.	→	A
Q.	07.	→	A
Q.	08.	→	C
Q.	09.	→	B
Q.	10.	→	A
Q.	11.	→	B
Q.	12.	→	D
Q.	13.	→	A
Q.	14.	→	B
Q.	15.	→	C
Q.	16.	→	B
Q.	17.	→	B
Q.	18.	→	C
Q.	19.	→	C
Q.	20.	→	C
Q.	21.	→	A
Q.	22.	→	C
Q.	23.	→	A
Q.	24.	→	B
Q.	25.	→	C
Q.	26.	→	C
Q.	27.	→	B
Q.	28.	→	B
Q.	29.	→	A
Q.	30.	→	C
Q.	31.	→	B
Q.	32.	→	A
Q.	33.	→	B
Q.	34.	→	A
Q.	35.	→	D
Q.	36.	→	B
Q.	37.	→	D
Q.	38.	→	C

Q.	39.	→	A
Q.	40.	→	C
Q.	41.	→	B
Q.	42.	→	B
Q.	43.	→	D
Q.	44.	→	A
Q.	45.	→	D
Q.	46.	→	D
Q.	47.	→	B
Q.	48.	→	B
Q.	49.	→	B
Q.	50.	→	B
Q.	51.	→	A
Q.	52.	→	D
Q.	53.	→	A
Q.	54.	→	C
Q.	55.	→	B
Q.	56.	→	C
Q.	57.	→	B
Q.	58.	→	D
Q.	59.	→	C
Q.	60.	→	C

Topic 24
Aromatic
Compounds

Q.	01.	→	B
Q.	02.	→	D
Q.	03.	→	B
Q.	04.	→	B
Q.	05.	→	C
Q.	06.	→	A
Q.	07.	→	B
Q.	08.	→	A
Q.	09.	→	C
Q.	10.	→	B
Q.	11.	→	B
Q.	12.	→	C
Q.	13.	→	D
Q.	14.	→	A
Q.	15.	→	A
Q.	16.	→	B
Q.	17.	→	A
Q.	18.	→	D
Q.	19.	→	A
Q.	20.	→	B
Q.	21.	→	C
Q.	22.	→	B
Q.	23.	→	C
Q.	24.	→	B

Q.	25.	→	B
Q.	26.	→	B
Q.	27.	→	B
Q.	28.	→	C
Q.	29.	→	B
Q.	30.	→	D
Q.	31.	→	C
Q.	32.	→	B
Q.	33.	→	D
Q.	34.	→	C
Q.	35.	→	B
Q.	36.	→	C
Q.	37.	→	C
Q.	38.	→	B
Q.	39.	→	A
Q.	40.	→	C
Q.	41.	→	B
Q.	42.	→	B
Q.	43.	→	D
Q.	44.	→	B
Q.	45.	→	C
Q.	46.	→	D
Q.	47.	→	C
Q.	48.	→	D
Q.	49.	→	A
Q.	50.	→	A

Topic 25
Organic
Compounds
Based On

Q.	01.	→	C
Q.	02.	→	C
Q.	03.	→	B
Q.	04.	→	A
Q.	05.	→	A
Q.	06.	→	C
Q.	07.	→	C
Q.	08.	→	B
Q.	09.	→	C
Q.	10.	→	C
Q.	11.	→	D
Q.	12.	→	B
Q.	13.	→	B
Q.	14.	→	C
Q.	15.	→	A
Q.	16.	→	A
Q.	17.	→	D
Q.	18.	→	B

Chemistry

- Q. 19. → C
Q. 20. → B
Q. 21. → A
Q. 22. → D
Q. 23. → A
Q. 24. → B
Q. 25. → A
Q. 26. → C
Q. 27. → D
Q. 28. → B
Q. 29. → A
Q. 30. → C
Q. 31. → C
Q. 32. → B
Q. 33. → B
Q. 34. → C
Q. 35. → A
Q. 36. → B
Q. 37. → C
Q. 38. → D
Q. 39. → C
Q. 40. → A
Q. 41. → B
Q. 42. → A
Q. 43. → B
Q. 44. → C
Q. 45. → C
Q. 46. → C
Q. 47. → D
Q. 48. → B
Q. 49. → C
Q. 50. → B
Q. 51. → D
Q. 52. → A
Q. 53. → B
Q. 54. → A
Q. 55. → C
Q. 56. → D
Q. 57. → B
Q. 58. → B
Q. 59. → B
Q. 60. → D

Topic 26

Chemistry Of Life

- Q. 01. → A
Q. 02. → B
Q. 03. → C
Q. 04. → B
Q. 05. → A
Q. 06. → A

- Q. 07. → A
Q. 08. → C
Q. 09. → B
Q. 10. → A
Q. 11. → C
Q. 12. → D
Q. 13. → C
Q. 14. → B
Q. 15. → B
Q. 16. → B
Q. 17. → D
Q. 18. → C
Q. 19. → C
Q. 20. → A
Q. 21. → B
Q. 22. → A
Q. 23. → C
Q. 24. → C
Q. 25. → D
Q. 26. → A
Q. 27. → C
Q. 28. → A
Q. 29. → A
Q. 30. → B
Q. 31. → B
Q. 32. → C
Q. 33. → B
Q. 34. → D
Q. 35. → A
Q. 36. → C
Q. 37. → A
Q. 38. → B
Q. 39. → C
Q. 40. → D
Q. 41. → B
Q. 42. → B
Q. 43. → A
Q. 44. → B
Q. 45. → A
Q. 46. → C
Q. 47. → B
Q. 48. → C
Q. 49. → A
Q. 50. → B
Q. 51. → C
Q. 52. → B
Q. 53. → D
Q. 54. → C
Q. 55. → B
Q. 56. → C

- Q. 57. → C
Q. 58. → B
Q. 59. → B
Q. 60. → D

Topic 27

Chemical Industries

- Q. 01. → D
Q. 02. → B
Q. 03. → A
Q. 04. → B
Q. 05. → A
Q. 06. → C
Q. 07. → C
Q. 08. → B
Q. 09. → C
Q. 10. → C
Q. 11. → C
Q. 12. → A
Q. 13. → A
Q. 14. → D
Q. 15. → A
Q. 16. → A
Q. 17. → B
Q. 18. → C
Q. 19. → B
Q. 20. → A
Q. 21. → C
Q. 22. → B
Q. 23. → C
Q. 24. → D
Q. 25. → A
Q. 26. → B
Q. 27. → B
Q. 28. → D
Q. 29. → B
Q. 30. → C

Topic 28

Experimental Techniques In

Chemistry

- Q. 01. → A
Q. 02. → C
Q. 03. → A
Q. 04. → B
Q. 05. → B
Q. 06. → C
Q. 07. → A

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Q.	08.	→	A
Q.	09.	→	B
Q.	10.	→	C
Q.	11.	→	B
Q.	12.	→	A
Q.	13.	→	A
Q.	14.	→	D
Q.	15.	→	A
Q.	16.	→	C
Q.	17.	→	B
Q.	18.	→	A
Q.	19.	→	B
Q.	20.	→	A
Q.	21.	→	D
Q.	22.	→	B
Q.	23.	→	C
Q.	24.	→	A
Q.	25.	→	D
Q.	26.	→	A

Inorganic Chemistry

(Miscellaneous Exercise)

Q.	01.	→	D
Q.	02.	→	B
Q.	03.	→	B
Q.	04.	→	C
Q.	05.	→	C
Q.	06.	→	B
Q.	07.	→	D
Q.	08.	→	B
Q.	09.	→	D
Q.	10.	→	C
Q.	11.	→	A
Q.	12.	→	B
Q.	13.	→	A
Q.	14.	→	C
Q.	15.	→	C
Q.	16.	→	C
Q.	17.	→	B
Q.	18.	→	B
Q.	19.	→	B
Q.	20.	→	C
Q.	21.	→	B
Q.	22.	→	A
Q.	23.	→	C
Q.	24.	→	D
Q.	25.	→	B
Q.	26.	→	A
Q.	27.	→	D
Q.	28.	→	A

Q.	29.	→	A
Q.	30.	→	C
Q.	31.	→	B
Q.	32.	→	B
Q.	33.	→	B
Q.	34.	→	B
Q.	35.	→	D
Q.	36.	→	C
Q.	37.	→	B
Q.	38.	→	D
Q.	39.	→	D
Q.	40.	→	C
Q.	41.	→	A
Q.	42.	→	B
Q.	43.	→	B
Q.	44.	→	D
Q.	45.	→	D
Q.	46.	→	D
Q.	47.	→	A
Q.	48.	→	C
Q.	49.	→	B
Q.	50.	→	C
Q.	51.	→	A
Q.	52.	→	B
Q.	53.	→	B
Q.	54.	→	C
Q.	55.	→	B
Q.	56.	→	A
Q.	57.	→	A
Q.	58.	→	D
Q.	59.	→	C
Q.	60.	→	D
Q.	61.	→	B
Q.	62.	→	D
Q.	63.	→	A
Q.	64.	→	C
Q.	65.	→	D
Q.	66.	→	D
Q.	67.	→	A
Q.	68.	→	B
Q.	69.	→	A
Q.	70.	→	A
Q.	71.	→	D
Q.	72.	→	B
Q.	73.	→	A
Q.	74.	→	A
Q.	75.	→	C
Q.	76.	→	D
Q.	77.	→	A
Q.	78.	→	B

Q.	79.	→	A
Q.	80.	→	C
Q.	81.	→	B
Q.	82.	→	C
Q.	83.	→	A
Q.	84.	→	A
Q.	85.	→	C
Q.	86.	→	B
Q.	87.	→	C
Q.	88.	→	D
Q.	89.	→	D
Q.	90.	→	D
Q.	91.	→	C
Q.	92.	→	A
Q.	93.	→	B
Q.	94.	→	A
Q.	95.	→	B
Q.	96.	→	C
Q.	97.	→	D
Q.	98.	→	A
Q.	99.	→	D
Q.	100.	→	C

Organic Chemistry

(Miscellaneous Exercise)

Q.	01.	→	D
Q.	02.	→	C
Q.	03.	→	B
Q.	04.	→	B
Q.	05.	→	B
Q.	06.	→	C
Q.	07.	→	D
Q.	08.	→	A
Q.	09.	→	C
Q.	10.	→	C
Q.	11.	→	B
Q.	12.	→	D
Q.	13.	→	D
Q.	14.	→	B
Q.	15.	→	A
Q.	16.	→	C
Q.	17.	→	B
Q.	18.	→	B
Q.	19.	→	C
Q.	20.	→	D
Q.	21.	→	D
Q.	22.	→	C
Q.	23.	→	B
Q.	24.	→	D
Q.	25.	→	D

Chemistry

- Q. 26. → A
- Q. 27. → D
- Q. 28. → D
- Q. 29. → B
- Q. 30. → A
- Q. 31. → B
- Q. 32. → C
- Q. 33. → A
- Q. 34. → D
- Q. 35. → C
- Q. 36. → B
- Q. 37. → A
- Q. 38. → A
- Q. 39. → C
- Q. 40. → A
- Q. 41. → B
- Q. 42. → C
- Q. 43. → D
- Q. 44. → B
- Q. 45. → A
- Q. 46. → C
- Q. 47. → A
- Q. 48. → D
- Q. 49. → C
- Q. 50. → C
- Q. 51. → A
- Q. 52. → A
- Q. 53. → A
- Q. 54. → C
- Q. 55. → A
- Q. 56. → B
- Q. 57. → B
- Q. 58. → A
- Q. 59. → D
- Q. 60. → C
- Q. 61. → A
- Q. 62. → A
- Q. 63. → C
- Q. 64. → B
- Q. 65. → B
- Q. 66. → C
- Q. 67. → D
- Q. 68. → B
- Q. 69. → A
- Q. 70. → C
- Q. 71. → D
- Q. 72. → A
- Q. 73. → C
- Q. 74. → B
- Q. 75. → C

- Q. 76. → B
- Q. 77. → B
- Q. 78. → D
- Q. 79. → A
- Q. 80. → B
- Q. 81. → B
- Q. 82. → B
- Q. 83. → C
- Q. 84. → A
- Q. 85. → C
- Q. 86. → C
- Q. 87. → A
- Q. 88. → B
- Q. 89. → B
- Q. 90. → C
- Q. 91. → B
- Q. 92. → A
- Q. 93. → B
- Q. 94. → C
- Q. 95. → A
- Q. 96. → B
- Q. 97. → D
- Q. 98. → C
- Q. 99. → A
- Q. 100. → B

Physical

Chemistry

(Miscellaneous Exercise)

- Q. 01. → A
- Q. 02. → C
- Q. 03. → C
- Q. 04. → C
- Q. 05. → A
- Q. 06. → B
- Q. 07. → C
- Q. 08. → C
- Q. 09. → D
- Q. 10. → B
- Q. 11. → D
- Q. 12. → C
- Q. 13. → B
- Q. 14. → C
- Q. 15. → A
- Q. 16. → B
- Q. 17. → C
- Q. 18. → A
- Q. 19. → B
- Q. 20. → C
- Q. 21. → B
- Q. 22. → B

- Q. 23. → A
- Q. 24. → B
- Q. 25. → C
- Q. 26. → C
- Q. 27. → B
- Q. 28. → C
- Q. 29. → C
- Q. 30. → B
- Q. 31. → D
- Q. 32. → D
- Q. 33. → B
- Q. 34. → C
- Q. 35. → A
- Q. 36. → D
- Q. 37. → C
- Q. 38. → A
- Q. 39. → A
- Q. 40. → A
- Q. 41. → C
- Q. 42. → B
- Q. 43. → C
- Q. 44. → D
- Q. 45. → B
- Q. 46. → D
- Q. 47. → C
- Q. 48. → B
- Q. 49. → D
- Q. 50. → D